Summary Report 1991-1992

Dimension Stone on Front Cover is:-

River Valley Black Anorthosite
(Dana Black)
Sudbury Area

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PREFACE

The formal inauguration of the Northern Ontario Development Agreement (NODA) took place in Sudbury, Ontario on November 4, 1991. At this time, Northern Ontario became the beneficiary of a four-year, $95-million subsidiary agreement, focused on the three key economic sectors of mining, forestry and tourism.

NODA continues a history of federal-provincial co-operation in these sectors and stems from an agreement signed in 1984 called the Canada-Ontario Economic and Regional Development Agreement (ERDA). This was a ten year federal-provincial initiative and commitment to regional and economic development in Ontario and replaced an earlier, similar General Development Agreement between Canada and Ontario.

The Canada-Ontario Mineral Development Agreement (COMDA), was signed in 1985 as one of five joint subsidiary agreements under ERDA. It provided for $30 million over five years, on a cost-shared basis between federal and provincial governments, and was intended to address mineral exploration and mining in Ontario. This subsidiary agreement ended on March 31, 1990.

Under the COMDA, five programs were initiated: 1) Geoscience, involving geoscientific studies of areas with mineral potential throughout the province; 2) Information Exchange, designed to develop a computerized system to compile, store and analyze information produced from mineral exploration; 3) Productivity and Technology, intended to develop improved computer software for mine design, measuring and analysis of stresses produced in backfilled areas and test new stoping and backfilling methods for relatively deep mines; 4) Economic Development, structured to study industrial mineral commodity markets and to identify new opportunities for and constraints to economic growth and 5) Public Information, Administration and Evaluation, intended to keep all interested persons informed of COMDA activities and to ensure the efficient implementation, administration and evaluation of the agreement.

The Minerals Program under NODA builds on COMDA's achievements. Of the $95 million jointly committed by Canada and Ontario, $30 million has been allocated to the Minerals sector. In Ontario, mineral production exceeds $6 billion annually, of which more than 80 per cent is exported. Ontario mines, smelters and refineries employ about 40,000 people, with another 50,000 working in secondary industries.

While many problems face the North, there are many new opportunities to support sustainable growth and development in the resource sector. Private sector investment and employment are expected through new technologies related to exploration and development, mining and new environmental requirements.

Given the special circumstances and development needs of northern Ontario, the approach to realizing its potential will rely on partnerships between government and the private sector.

INTRODUCTION

The administration and communications aspects of the Agreement were initiated in early 1991. From the provincial perspective, an Ontario Minerals Co-ordinator was appointed to represent Minerals in the initial discussions and internal negotiations involved with the development of a new, regionally based agreement. In addition, projects were developed through extensive involvement of inter-branch expertise and a mechanism put in place for greater industry involvement in the project priority process. Energy, Mines and Resources Canada was consulted throughout this period, as EMR similarly developed projects which would meet the objectives defined within the proposed agreement.

Ontario, in advance of an expected signed agreement, released funds at the start of the 1991/92 year, to initiate several projects which had been previously identified. A summary of progress for most of these projects comprises the bulk of this report. Many of the remaining projects are presently being finalized and will be activated over the next several months. A news bulletin is planned for mid-summer which will identify more completely the location of projects initated by both the Federal and Provincial governments.

The Ontario Ministry of Northern Development and Mines, together with Energy, Mines and Resources Canada, having taken the initiative in the overall NODA, were responsible for design of a new logo for use by each sector comprising the agreement. The design element was created with the view of maintaining links to the previous COMDA but establishing a distinct identity through colour consistency and providing each sector with its own unique identity, yet retaining the theme of an overall joint umbrella initiative. Additionally, the overall launch and media efforts related to the formal signing in Sudbury, and simultaneous announcements in other northern communities receiving the benefits of some of the projects, were co-ordinated by the Minerals sector.

Summary displays and summary of progress presentations were developed and presented at the Ontario Mines and Minerals Symposium in Toronto in December, 1991 and at the Geological Survey of Canada Minerals Colloquium in Ottawa in January, 1992.

Despite the late start resulting from the November signing of the Agreement, the co-operative efforts of the Ontario Ministry of Northern Development and Mines and Energy, Mines and Resources Canada, has led to an effective first year implementation of programs. With continued liaison with industry representatives, the remainder of the projects will be implemented starting in 1992/93 and results communicated to the industry and general public through a variety of means.

CANADA — ONTARIO SUBSIDIARY AGREEMENT ON NORTHERN ONTARIO DEVELOPMENT

This Agreement made this 4th day of November, 1991

BETWEEN **THE GOVERNMENT OF CANADA**, as represented by the Minister of Industry, Science and Technology, (herein referred to as "Canada")

OF THE FIRST PART,

AND **THE GOVERNMENT OF ONTARIO**, as represented by the Treasurer of Ontario and Minister of Economics, (herein referred to as "Ontario")

OF THE SECOND PART.

WHEREAS Canada and Ontario have entered into an Economic and Regional Development Agreement dated November 2, 1984 (hereinafter referred to as the "ERDA") to achieve the objectives stated in section 3 thereof;

AND WHEREAS Canada and Ontario have agreed to assist in the development of the forestry, minerals, and tourism sectors in Northern Ontario;

AND WHEREAS subsection 13(6) of the Department of Industry, Science and Technology Act authorizes the Minister of Industry, Science and Technology to enter into agreements in relation to regional economic development in Ontario with the Government of Ontario;

AND WHEREAS the Lieutenant Governor in Council of Ontario, by Order in Council No. 2428/91 dated October 9, 1991, has authorized the Treasurer of Ontario and Minister of Economics to sign this Agreement on behalf of Ontario;

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the premises, covenants, and agreements, herein contained, the Parties hereto agree as follows:

1.0 Definitions

In this Agreement:

(a) "Agreement" means this Canada-Ontario Subsidiary Agreement on Northern Ontario Development made pursuant to the Canada-Ontario ERDA;

(b) "Eligible Costs" means all reasonable and proper costs incurred by the Parties under contracts or agreements entered into in accordance with this Agreement by Canada and Ontario with any person, corporation, or agency for the acquisition of equipment, for the performance of work or for services, together with salary and other costs specifically related to the employment of staff to implement Programs and Projects under this Agreement.

(c) "Evaluation Framework" means an outline of the means by which Programs may be evaluated in accordance with the ERDA and the objectives of this Agreement, with respect to their socio-economic impact;

(d) "Federal Implementing Minister" means a Minister responsible for delivering the Federal

component of a Program Schedule, being the Minister to whom responsibility for the subject matter of the Program Schedule is by law assigned;

(e) "Federal Minister" means the Minister of Industry, Science and Technology or any other person authorized to act on his behalf;

(f) "Fiscal Year" means the period commencing on April 1 of a given year and terminating on March 31 of the immediately following year;

(g) "Implementing Ministers" means the Federal Implementing Minister and the Provincial Implementing Minister;

(h) "Implementing Party" means the Party which has the responsibility for delivering a Program or Project;

(i) "Management Committee" means the committee established pursuant to section 4.1 of this Agreement to manage and administer this Agreement;

(j) "Management Subcommittee" means a committee established pursuant to subsection 4.2(d);

(k) "Ministers" means the Federal Minister and the Provincial Minister;

(l) "Northern Ontario" means the portion of Ontario lying north of the southern limits of the Nipissing and Parry Sound Districts;

(m) "Program" means the principal components of the Program Schedules "B", "C" and "D" of this Agreement;

(n) "Program Schedule" means the Programs outlined in any one of Schedules "B", "C" and "D";

(o) "Project" means a subdivision of a Program

(p) "Provincial Implementing Minister" means a Minister responsible for delivering the Provincial component of a Program Schedule;

(q) "Provincial Minister" means the Treasurer of Ontario and Minister of Economics or any person authorized to act on his behalf; and

(r) "Termination Date" means the last date by which Projects may be approved, which date shall be determined in accordance with section 5.1

2.0 Purpose and Objectives

2.1 The purpose of this Agreement is to give effect to the ERDA and the objectives as provided therein and in particular to implement Program Schedules B, C, and D.

2.2 The objectives of the Agreement are:

(a) to encourage economic development and diversification in Northern Ontario by the development and implementation of strategies for sustainable development in forestry, minerals and tourism;

(b) to foster steady, long-term and competitive performance by;

(i) maintaining and upgrading the quality and management of natural resources;

(ii) encouraging technological innovation and transfer in forestry, minerals and tourism;

(iii) promoting and assisting product and market development; and

(iv) encouraging human resource development.

(c) to facilitate cooperation between Ontario and Canada in the economic development of Northern Ontario; and,

(d) to enhance the public understanding of the challenges of sustainable development of the resource base and the significant efforts made by Canada, Ontario and the private sector towards addressing them.

3.0 Implementation

3.1 In order to achieve the objectives outlined in section 2 above, the Parties hereto agree:

(a) to implement Program Schedules "B", "C" and "D" in respect of forestry, minerals and tourism;

(b) to ensure all Programs and Projects to be carried out under this Agreement meet the requirements of all environmental protection legislation of the parties, including the Environmental Assessment and Review Process Guidelines Order made pursuant to the Government Organization Act. 1979 and the Environmental Assessment Act, R.S.O. 1980, c.140, as amended, and that such Programs and Projects are carried out in accordance with any and all such legislation;

(c) to ensure all Programs and Projects established under this agreement in response to the particular needs of aboriginal persons and communities in no way alter the benefits they derive from other programs or commitments of the Government of Canada or the Government of Ontario, and to ensure that aboriginal peoples have full and equal access to appropriate funding under this Agreement;

(d) to undertake the Programs and Projects in accordance with the terms and conditions of this Agreement.

4.0 Management and Coordination

4.1 The Ministers shall appoint a Management Committee to manage and administer this Agreement. The Management Committee shall;

(a) have two voting members, one of whom is to be appointed as co-chairperson by the Federal Minister and one of whom is to be appointed as co-chairperson by the Provincial Minister;

(b) have two non-voting members, appointed by Ministers as in 4.1(a);

(c) invite, when appropriate, observers to meeting of the Management Committee;

(d) have the co-chairpersons or their designates attend all meetings of the Management Committee;

(e) act only on decisions taken unanimously, and refer any matter on which the Management Committee is not unanimous to the Minsters, whose decision is final; and

(f) continue to exist and to operate for as long as necessary to meet the requirements of this Agreement.

4.2 The Management Committee shall be responsible for the overall management and coordination of the Agreement and, included in their duties, shall:

(a) meet at least annually for the purposes of this Agreement:

(b) ensure the necessary cooperation exists between Ontario and Canada for the design, development, implementation and evaluation of the Programs and Projects arising form this Agreement;

(c) establish all procedures in respect to its own meetings, including rules for the conduct of meetings and the making of decisions where the members are not physically present in one place;

(d) establish a Management Subcommittee to be responsible for each Program Schedule, and other subcommittees as required to manage this Agreement;

(e) delegate to each Management Subcommittee the authority to carry out the prompt development and implementation of Programs and Projects that shall be consistent with the objectives of this Agreement;

(f) submit to Ministers annually, or as requested, status reports as to the progress of this Agreement, actual and planned expenditures and any recommendations deemed appropriate;

(g) adopt such procedures, forms, reports and guidelines consistent with this Agreement, as it deems expedient and appropriate to achieve its purpose;

(h) make every effort to ensure that the funding commitments made herein by each Party are met.

4.3 Each Management Subcommittee shall be responsible for and have all duties and powers necessary to implement its respective Program Schedule, and shall:

(a) have two voting members, of whom one is appointed as co-chairperson by the respective Federal Implementing Minister and one appointed as co-chairperson by the respective Federal Implementing Minister and one appointed as co-chairperson by the respective Provincial Implementing Minister;

(b) appoint non-voting members;

(c) invite, when appropriate, observers to meetings of their Management Subcommittee;

(d) have the co-chairpersons or their designates attend all meetings of their Management Subcommittee;

(e) act only on decisions taken unanimously;

(f) refer any matter with respect to which a Management Subcommittee is not unanimous first to the Implementing Ministers and second, if necessary, to the Management Committee;

(g) continue to exist and to operate for as long as is necessary to meet the requirements of this Agreement.

4.4 Each Management Subcommittee shall be responsible for the overall management and coordination of its Program Schedule and shall;

(a) meet at least twice per Fiscal Year for the purposes of this Agreement;

(b) establish all procedures and practices for the review and approval of Programs and Projects, the conduct of meeting, the making of decisions where the members are not physically present in one place, and the appointment of non-voting members;

(c) keep detailed and accurate accounts and records of expenditure for each Program and Project;

(d) prepare and approve, before the start of each Fiscal Year during which this agreement is in effect, an annual workplan identifying which of the Projects will be carried out in the Fiscal Year, the Implementing Party, the anticipated completion date, and the budgeted funds to be attributed to each Program and Project for the year;

(e) develop annually, and in whole or in part as and when requested, for the Management Committee, financial and management information reports which shall, at minimum, provide statements of actual expenditures for previous Fiscal Years, up to date cash flows during the current Fiscal Year, and estimated cash flows on existing and anticipated commitments during each remaining Fiscal Year, reported by Fiscal Year and by Program and Project;

(f) ensure that all contracts and agreements entered into to implement its Program Schedule incorporate all relevant provisions of this Agreement;

(g) establish technical and other subcommittees as may be required from time to time and authorize these subcommittees to perform such tasks as the Management Subcommittee deems appropriate;

(h) carry out any other duties or functions specified elsewhere in this Agreement or such as may be assigned by the Management Committee to accomplish the objectives of this Agreement;

(i) adopt such procedures, forms, reports, and guidelines, as specified under section 4.2(g) and others it deems expedient and appropriate to achieve its purpose;

(j) in exercising the powers, duties, and functions of a Management Subcommittee the federal members will consult as appropriate with the Department of the Environment on the environmental impact; Employment and Immigration Canada on the human resource implications; and the Departments of Indian Affairs and Northern Development and Industry, Science and Technology on the impact on aboriginal peoples of Programs under this Agreement.

5.0 Duration

5.1 This Agreement shall be of full force and effect as of April 1, 1991. The Termination Date of this Agreement shall be March 31, 1995, or on such earlier date as may be agreed to in writing by the Ministers.

6.0 Administration

6.1 No Project shall be approved after the Termination Date of this Agreement. Unless otherwise agreed by the Management Committee, no Project completion date shall extend beyond March 31 of the second full Fiscal Year following the Termination Date, and no claim shall be paid by either Party, unless it is received by such party by March 31 of the second full Fiscal Year following the Termination Date.

6.2 Subject to section 7.1 and 7.2 each Party hereto shall be responsible for contributing to the Eligible Costs of Projects undertaken under this Agreement in accordance with the determinations of the Management Subcommittee pursuant to subsection 4.4(d).

6.3 Each Project shall be described in an appropriate Project authorization form which, at minimum, shall specify the Implementing Party, provide for the Project name and description, the Program of which if forms a part, its purpose and objectives, environmental impacts (if any), location, and outline of the way the Project is to be carried out and progress reported, the total cost of the Project and the share of the cost to be borne by each Party.

6.4 The Implementing Party for a Project shall be responsible for taking such steps as may be necessary to carry out the Project in question. In particular, the Implementing Party may enter into one or more contracts or agreements for this purpose, or may use its own resources.

6.5 Nothing in this Agreement prevents Canada or Ontario from contracting the services of the other in the implementation of all or part of any Program or Project.

7.0 Financial Provisions

7.1 Notwithstanding anything in this Agreement, the total contribution by Canada under this Agreement shall not exceed $47.5 million, allocated by Program Schedule up to the amounts shown as follows:

Forestry $25.0 million
Minerals $15.0 million
Tourism $7.5 million

7.2 Notwithstanding anything in this Agreement, the total contribution by Ontario under this Agreement shall not exceed $47.5 million, allocated by Program Schedule up to the amounts shown as follows:

Forestry $25.0 million
Minerals $15.0 million
Tourism $7.5 million

7.3 Schedule "E" indicated the allocation of funds.

7.4 A Management Subcommittee may reallocate funds within its Program Schedule budget.

7.5 Transfers of funds between Program Schedules shall be subject to the amendment procedures as set out in section 13.2.

7.6 The financial obligations of Canada hereunder are subject to the express condition that there be an appropriation by the Parliament of Canada for the funds necessary for the Fiscal Year in which they are required.

7.7 The financial obligations of Ontario hereunder are subject to the express condition that there be an appropriation by the Legislative Assembly of the Province of Ontario for the funds necessary for the Fiscal Year in which they are required.

8.0 Payment Procedures

8.1 Canada and Ontario shall fund Projects unilaterally, or in the proportion specified, in accordance with the determination of each Management Subcommittee pursuant to subsection 4.4(d).

8.2 In the case of cost-shared Projects, each Implementing Party shall be entitled, in respect of Eligible Costs which it has incurred and paid, to recover from the other Party its share of such Eligible costs.

8.3 Payments to an Implementing Party, required pursuant to section 8.2, shall be made promptly by the other Party on the basis of progress claims setting out Eligible Costs actually incurred and paid by the Implementing Party for the Project, submitted and verified in a manner satisfactory to the Management Subcommittee.

9.0 Inspection and Audit Procedures

9.1 Canada and Ontario shall each ensure that proper and accurate accounts and records are maintained during the Agreement and for three years following the Termination Date, with respect to each Project which it implements, and shall make those accounts and records available to the other Party for inspection and audit.

9.2 Each of the Parties may inspect the amounts of all claims of the other in respect of any Project which the other has implemented and the accounts and records related thereto. Any discrepancy between amounts paid by any of the Parties and the amount payable under this Agreement shall be promptly adjusted between the Parties.

9.3 The Management Committee shall jointly carry out or cause to be carried out a financial audit within three years of the Termination Date.

10.0 Evaluation

10.1 Each Management Subcommittee established under subsection 4.2(d) shall, for its Program Schedule, develop an Evaluation Framework which shall set out measurable objectives. Each Evaluation Framework shall be approved by the Management Committee within one year following the execution of the Agreement.

10.2 An evaluation report, satisfactory to the Management Committee, will be required for each Program Schedule; each evaluation report shall be submitted to the Management Committee within two years of the Termination Date of this Agreement.

10.3 The Parties hereto agree to conduct, at the end of the third year from the execution of this Agreement, a joint review of Programs and Projects carried out to date, sufficient to determine whether any change in Program content is required for the remainder of the Agreement.

10.4 The Parties hereto each agree to provide the other with information necessary for the evaluation of Programs and Projects under this Agreement.

11.0 Public Information

11.1 Canada and Ontario hereby agree to the procedures respecting public information, as set out in Schedule "F" to the Agreement, and hereby delegate implementation responsibility for such procedures to the Management Committee.

12.0 General

12.1 No member of the House of Commons of Canada or the Legislature of Ontario shall be admitted to any share or part of the Agreement, or to any share or part of any contract, agreement or commission made pursuant to this Agreement, or to any benefit arising therefrom.

12.2 Nothing in this Agreement is to be construed as authorizing one Party to contract for or to incur any obligation on behalf of the other or to act as agent for the other.

12.3 This Agreement, including Schedules "A" to "F" hereto, forms the entire agreement.

12.4 This Agreement shall be interpreted subject to the provisions of the ERDA. In the event of a conflict between this Agreement and the ERDA, the ERDA shall prevail.

12.5 All property, including patents, copyrights, software, and other intellectual property and any revenue acquired as a result of the work performed under a Project shall be disposed of, licensed, or otherwise dealt with as Ministers, upon recommendation of the Management Subcommittee, may from time to time determine — all subject to such legal and other authority as may be necessary pursuant to legislative and policy requirements.

13.0 Amendment

13.1 Canada and Ontario may from time to time amend the provisions of this Agreement by written agreement of the Ministers.

13.2 It is expressly understood and agreed, however, that any amendment to the Objectives of this Agreement, as set out in section 2, or to the financial limitations, as set out in section 7.1 and 7.2, shall require the prior approval of Treasury Board for Canada and the Lieutenant Governor in Council for Ontario

IN WITNESS WHEREOF this Agreement has been executed on behalf of the Government of Canada by the Minister of Industry, Science and Technology, and on behalf of the Government of Ontario by the Treasurer of Ontario and Minister of Economics.

GOVERNMENT OF CANADA

Minister of Energy, Mines and Resources

Minister of State Small Business and Tourism

Minister of Industry, Science and Technology

Minister of Forestry

GOVERNMENT OF ONTARIO

Minister of Northern Development and Mines

Minister of Natural Resources

Treasurer of Ontario and Minister of Economics

Minister of Tourism and Recreation

Schedule "A"
The Economic Environment of Northern Ontario

The economy of Northern Ontario is dominated by three major sectors: mining, forestry and tourism. These sectors developed the north and will continue to be the principal growth areas in the future.

While mining and forestry are based primarily in the north, they also contribute significantly to the overall Ontario economy. Mineral production exceeds $6 billion annually of which over 80 per cent is exported. About 40,000 are employed in Ontario's mines, smelters and refineries with another 50,000 working in the metals and minerals semi-fabricating industry. Similarly, Ontario forest products such as lumber, pulp, newsprint and specialty papers produce revenue of approximately $10 billion annually of which over 40 per cent is exported. Direct and indirect employment was as high as 200,000 in 1987, but has declined in recent years.

Tourism spending in Northern Ontario amounted to $1.7 billion in 1990 of which 24 per cent came from out of province travellers. This compares with $15.5 billion for all of Ontario. Direct employment in Northern Ontario supported by tourism activities is estimated to be over 18,200.

A number of basic changes are currently occurring within certain resource sectors. These changes appear to be permanent rather than a consequence of a boom and bust cycle. For example, iron ore and uranium mines are being closed because they no longer are cost competitive. Similarly in forest products, many sawmill operators can no longer compete with other commodity lumber producers. There is also concern that growing demand for recycled paper products will result in future paper mills being located adjacent to the densely populated cities in the United States, thus resulting in permanent mill closures in Northern Ontario. Cyclical factors have also reduced base metal, gold, lumber and newsprint prices during the last year. These and other challenges are forcing a number of northern resource industries to restructure their operations. The recession and a high Canadian dollar have also compounded the problems of many resource producers.

Despite some growth in employment in its service industries, Northern Ontario does not enjoy the economic diversity sufficient to offset the cyclical fluctuations in its primary industries, or the constraints of distance and climate.

While many problems face the North, new opportunities in support of sustainable growth and development are available in the resource and tourism sectors. The development of new technology related to exploration and development, mining and forestry operations, reforestation and new environmental requirements are expected to generate private sector investment and employment. Tourism has also been identified by many communities as an area with growth prospects. Improved marketing, community infrastructure and new attractions are required if the North is to realize its tourism potential.

In summary, mining, forestry and tourism are expected to maintain their historical prominence in the continuing development of Northern Ontario. Given the special circumstances and development needs of Northern Ontario, the approach to realizing its potential needs to be a blend of public assistance, private sector support and regional/sectoral promotional programs.

Schedule B
Forestry — $50 Million

Background

Ontario's forests have long provided a broad range of benefits to its original inhabitants including shelter, food, tools, medicine and spiritual renewal. With the European colonization of these forests for homesteaders and farmers, the commercial value of Ontario's vast supply of valuable timber was realized. For almost the last two centuries, Ontario's forests have steadily yielded increasing volumes of wood for a major cornerstone of the provincial economy — the forest products industry. The early loggers and entrepreneurs that opened the Ontario forest frontier established a pattern of settlement that continues to be evident today, with many northern communities heavily dependent upon the forest for their livelihood. The access developed by the early loggers also opened opportunities for subsequent economic development in mining, tourism, recreation and energy production.

In economic terms, the forests of northern Ontario provide a feedstock for one of the largest forest products sectors in Canada. Provincial production is valued at $10 billion (23% of the value of Canadian industry shipments). The industry provides direct employment for over 80,000 workers across Ontario and sustains the economy of over 30 resource-based communities in the north. The forest also provides the backdrop for a multi-million-dollar tourist industry which is quickly becoming a larger user of the northern landscape.

The northern forest is predominantly provincial crown land and its management has been guided by a broad range of strategic and specific policies and plans. In 1972, Ontario approved a Forest Production Policy which specified target levels of forest renewal and tending in order to achieve a goal of sustaining an annual harvest of 25.8 million m^3/year by the year 2020. Based on this strategy of sustained yield, the provincial investment in forest renewal escalated dramatically from $87 million/year in 1977 to $319 million/year in 1988. During this time, the forest industry, through the Forest Management Agreement program, became a major partner in forest management. In the mid 1980's, a third major stakeholder was encouraged to participate in forest management — the public. The mechanism for this input was through public and stakeholder participation in the Timber Management Planning and Land Use Planning processes.

In 1984, Canada and Ontario each invested $75 million in forest management through the Canada-Ontario Forest Resource Development Agreement (COFRDA). During its term, COFRDA funded the regeneration of 110,000 hectares of forest land, purchased 166 million seedlings, financed construction of 400 kilometres of forest access roads and made many important contributions to advancing the state of knowledge and technology in Ontario forestry. This partnership has had an enduring impact on provincial forestry programs by funding directly a 20% annual increase in silvicultural activity. This included an increase in annual tree planting activity from a level of 110 million trees/year in 1984-1985 to 160 million/year in 1988-1989. Since the expiry of COFRDA, Ontario has maintained this commitment and has expanded the overall provincial forest management program. Canada's contribution to forestry

in Ontario continues to be mainly through a multidisciplinary program of research and development which in 1990-1991 accounted for expenditures in excess of $15 million.

Although a policy based on sustainable supply of timber was appropriate for the 1970's and 1980's in terms of timber supply, it does not reflect expected industrial restructuring and does not incorporate other uses and values of the forest. In recognition of this, forest management in Ontario will be guided in the 1990's by a strategy of Sustainable Forestry which balances economic, social and environmental concerns across the provincial forest landscape and responds to the public interest in participating in designing the future of the public forest.

Sustaining Ontario's Forest Sector

During most of the last two centuries, the extraction of quality timber at least cost was the only consideration of loggers and forest entrepreneurs. Even though it was recognized that the supply of timber was not endless, it was not until the early 1970's that the emphasis in forest management shifted from allocation and protection to forest renewal and integrated use. During the last two decades, other uses of the forests have been considered in forest management decision-making and been incorporated as constraints to commercial operations. Tourism, wildlife, fisheries, recreation, preservation and aboriginal interests as legitimate uses of the forests, have historically been characterized as constraints to the production of commercial wood products. Viewing these other uses as constraints to the production of timber has led to the present dilemma of multiple-use across the forest with varying degrees of constraint on timber production depending on location and pressures from other users.

Moving from a policy of Sustained Yield to Sustainable Development in forestry requires a broader base of information incorporating other forest values. Sustainable Forestry involves some dramatic shifts in perspective and provides for new participants in forest management decision-making. This philosophy also recognizes the need for comprehensive and accessible forestry information, the importance of scientifically sound decision-making and the need for balancing social and economic goals in forest management. Major challenges to the addressed before achieving Sustainable Forestry include filling information shortfalls related to: forest ecosystem processes; quantification and interrelationships of forest values; present and future growth of the forest; and the development of alternative forest management techniques that accommodate a wider range of forest values. The public debate of the use of the forest must be built upon a solid foundation of credible and understandable information accessible to all participants in order to provide a basis for common understanding and productive dialogue. Whereas earlier federal-provincial initiatives in forestry focused on securing the 'supply' of timber resources, the Norther Forestry Program will focus on information for better tools and ultimately better decisions, in the management of Ontario's forests for economic, social and environmental prosperity.

Canada's environmental agenda, the Green Plan, has set a clear course of action for federal departments and is a reflection of Canadians' concern over the environment and interest in Sustainable Development. The Green Plan provides definite targets and schedules which will drive environmental initiatives within federal jurisdiction — relying, however, on co-operative arrangements to achieve success. Against this backdrop of shared environmental interest from both Canada and Ontario, the Northern Forestry Program is designed to address the eight principles of federal-provincial programs accepted by the Canadian Council of Forest Ministers.

i) Long Term Planning

Ontario is in the process of launching the development of a Comprehensive Forest Policy Framework through consultation with a wide array of stakeholders. This will incorporate long-term objectives for provincial forests, address key public issues and involve an open and consultative public participation process. Within this context, a Timber Production Policy is being developed which will recommend options for securing a sustainable supply of timber to meet Ontario's social, economic and environmental needs. The integration of other uses in management planning is in place through the Area Planning concept which involves the equal participation of forest, wildlife, recreation. fisheries and lands managers, including aboriginals, as well as full participation by the public in the process.

ii) Improved Forestry Data

Through the Canadian Council of Forest Ministers, the National Forestry Database is being developed and Ontario is a key contributor to its success. The collection of data in support of improved decision support systems, applied research and technology transfer and economic analysis are important features of the Northern Forestry Program.

iii) Responsibilities for Silviculture

The Northern Forestry Program will be targeting its resources to enhancing the capability of managers to better manage by providing more and better information and better tools. Effective silviculture, as one of many obligations of a responsible forest steward, will continue to be an important provincial priority and an essential element of a new Timber Production Policy. Both levels of government will be working co-operatively with aboriginal people to improve the quality of forest management on reserves, access to off-reserve resources and to reinforce their capability to become stewards of their forests.

iv) Integrated Resource Management

The principle of integrated resource management has long been part of management planning at a local and regional level. The developing Comprehensive Forest Policy will embody the philosophy of integrated use through the establishment of a provincial decision-making framework that incorporates timber and non-timber values. Demonstrations of integrated forest use will be supported through the Program.

v) Research, Development and Technology Transfer

Both Canada and Ontario have committed over 50% of available Program funding to this high priority through the Sustainable Forestry Development Program. Outside of this agreement, Ontario is investing about $25.0 million/year and Canada about $15 million/year in forestry research, development and technology transfer in Ontario. Research and development priorities will be guided by OMNR Sustainable Forestry agenda and the Forestry Canada regional strategic plan. A specific multi-year strategy reflecting client and user interests will set the direction of these activities in the Program.

vi) Incrementality

Ontario has shown a marked increase in investment in forest management to meet the challenges presented by sustainable forestry. Through the Sustainable Forestry Initiative,

Ontario has demonstrated a major financial commitment to responsible forest management over the long term. Aboriginals, as committed land stewards, will be contributing to the forest management programs on reserve lands.

vii) Public Awareness

A jointly developed communications strategy will guide the public information and awareness programs of both partners to the Program. The importance of well managed forest and its contribution to the economy and environment, the role of the Program in furthering the goals of Sustainable Development and the commitment of both Canada and Ontario to Sustainable Forestry will be major themes of the communications strategy.

viii) Human Resource Development

Improving the capability and knowledge base of forest managers will be supported through the Aboriginal Forestry Development Program and professional and technical development activities in the Communications, Awareness and Education Program. The timely transfer of results of applied research under the Program will be stressed through publications, workshops and symposia.

Northern Forestry Programs

The Purpose and Objectives of Section 2.0 provide a framework within which the Northern Forestry Program is designed in order to address the joint priorities of Canada and Ontario in achieving sustainable development in forestry. More specifically, the program is developed to achieve the following goals:

- to undertake programs of applied research and technology transfer that provide information in support of sustainable forestry in Ontario;

- to provide improved capability to forest managers through improved decision support systems, advanced silvicultural training, development of alternative forest management techniques, collection and publication of forestry information and expanded economic analysis of the forest sector;

- to support the economic development of aboriginal people through on-reserve forest management programs, access to off-reserve resources and enhances forestry training; and

- to promote broader understanding of the forest, the values it generates and the contributions of Canada and Ontario to its sustainable use.

In order to achieve these goals, the following four programs will be developed and delivered:

1. Sustainable Forestry Development - $32 Million

This program will fund projects designed to contribute to the major components of the sustainable forestry initiative in Ontario. It will involve applied research and technology transfer programs such as improving decision support tools for managers, economic analyses including evaluation of non-timber values and resource evaluation and trade-offs in planning, expanded information in forest growth and yield and forest management systems, forest ecosystem classification, development of guidelines for boreal mixedwood management, opportunities for alternative forest management techniques and forestry demonstrations in integrated resource management (IRM).

1.1 Applied Research
1.2 Technology Development and Transfer
1.3 Decision Support
1.4 Socio-Economic Analyses
1.5 IRM Demonstration Areas

2. Aboriginal Forestry - $12 Million

This program has three major thrusts, the first being a program of training and communications that builds upon and expands the federal "Indian Land Program" established in 1985. The second component includes aboriginal access to and participation in provincial crown land forestry activities including silviculture, resource protection planning and support for on-reserve forestry. The third component will explore initiatives to enhance forestry training for aboriginal people at the post-secondary school level in partnership with diploma and degree granting institutions.

2.1 Reserve Lands Forestry
2.2 Provincial and Agreement Lands Forestry
2.3 Training and Education

3. Communications, Awareness and Education - $4 million

This program will provide support for achieving the goals of the Northern Ontario Development Agreement as they relate to enhancing the public understanding of the challenges of sustainable development in the forest sector and the significant efforts being made by Canada and Ontario to address them. A comprehensive four-year program of communications and public information will be developed and include expanded awareness of forestry in the education system through the "Focus on Forests" school program. A program of maintaining and/or upgrading the technical credentials and skills of forest managers will be developed through technical upgrading programs, development and exchange opportunities and specialized training.

3.1 Communications
3.2 Forestry Awareness
3.3 Forest Education

4. Management and Evaluation - $2 million

This program will provide the resources required for implementing agencies to undertake their responsibilities in delivering and administering programs. Funding is also provided for program evaluation which includes the development, establishment and maintenance of a management information system for tracking and reporting on Program activities. The northern forestry program component of the Agreement annual report may include activities undertaken by Canada or Ontario outside this agreement, but which contribute to its objectives.

4.1 Management Support
4.2 Evaluation

Schedule C
Minerals Programs — $30 Million

The aims and objectives of these Federal and Provincial programs for Northern Ontario — designed to help the mineral industry improve and diversify its contribution to the economy of Ontario — are briefly described below.

1. Geoscience — $9 Million

The program is designed to identify geological environments favourable for exploration. Emphasis is to be placed on increasing the understanding of basemetal sulphide deposits, with particular focus on mining-dependant areas that have significant, potential for the discovery and development of additional, similar resources.

2. Mining and Minerals Technology — $9 Million

The bulk of this program will be developed and carried out in conjunction with the mining industry. The projects are designed to enhance the competitiveness of the Ontario mining industry while addressing environmental concerns and declining base metal reserves.

Mining research will include continuation of the backfill studies initiated under COMDA, investigation of mining methods analysis of stress patterns for ground control studies, and health and safety concerns related to mine environments and other areas which may lead to technological advances and improvements in productivity, competitiveness and safety.

Processing research will focus on mitigating the effects of mining and milling activities, the development of process instrumentation and metallurgical studies. Problems related to neutralizing acidic mine drainage also will be addressed under the Ontario component of the Mine Environmental Neutral Drainage (MEND) Program.

3. Information Transfer and Technology — $5.5 Million

This program will use state-of-the-art information technology to significantly improve private sector access to government mineral information files. Projects will focus on development of databases and applications for geoscience, mining, environmental and land use purposes. They will also incorporate compilation and electronic production of different maps. Applications and integration of related digitized data sources, available through other agencies, will also be investigated.

4. Exploration Technology — $2 Million

The objectives of this program are to develop interpretation technologies for airborne geophysical data which could be used by the minerals industry. Additionally, research into borehole instrumentation, such as geochemical and geophysical sensors, will be undertaken.

5. Industrial Minerals and Economic Development — $2.5 Million

The program aims to examine opportunities and problems faced by the industrial minerals sector and to identify potential new sources in Northern Ontario for some of these commodities. Projects will provide information on a variety of related aspects, including commodity specifications, marketing, current and potential uses, and new materials and technologies.

6. Administration, Communications and Evaluation — $2 Million

These activities are to ensure that the Minerals Program is properly managed, and that the public and the minerals industry are adequately informed of activities being undertaken and of the challenges that face the province's minerals industry.

Schedule D
Tourism Programs — $15 Million

1. Tourism Marketing — $3.9 Million

The objective of the marketing program is to develop cooperative arrangements in marketing with public bodies, private industry and government agencies in order to promote the unique natural, cultural, and resource strengths of the tourism industry in Northern Ontario.

Implementation

Projects may be implemented under this program by Canada or the Province. Funding may be joint or unilateral. Unilaterally funded projects will be implemented by the party providing the funds. Jointly funded projects may be implemented by either party.

Selection Criteria

Assistance will be provided to individuals, partnerships, incorporated associations, corporations, government agencies, and any other legal entity undertaking an eligible project. Priority will be given to projects which reinforce marketing in Ontario, or targets overseas and long haul U.S. markets. Emphasis will be to enter into cooperative marketing activities, including winter and summer touring packages, on either an individual or consortium basis.

The program is designed to assist with incremental marketing activities only. The applicant must submit a two year marketing plan for consideration. Projects eligible for funding under other government programs will not normally be eligible for assistance under this program.

Assistance in the form of contributions will be tailored to the needs of the applicant and not exceed 90% of the eligible costs of the project.

2. Database and Market Research Studies — $1.6 Million

The objective of the (a) database and (b) market research program is to provide assistance to research activities by government agencies, public and private industry including sectoral and regional analyses which are necessary to support the tourism industry in Northern Ontario. The development of a Northern Ontario economic information system database will be implemented by the Province. Market research studies will be implemented by Canada.

Implementation

Projects may be implemented under this program by Canada or the Province. Funding may be joint or unilateral. Unilaterally funded projects will be implemented by the party providing the funds. Jointly funded projects may be implemented by either party.

Selection Criteria

Assistance will be provided to individuals, partnerships, incorporated associations, corporations, government agencies, and any other legal entity undertaking and eligible project.

Projects eligible for funding under other government programs will not normally be eligible for assistance under this program.

Assistance in the form of contributions will be tailored to the needs of the applicant and not exceed 90% of the costs of the project.

NOTE: For projects in programs 1 and 2 above which are federally implemented or federally funded, in whole or in part, eligible recipients shall not include any federal entity.

3. Community Market Service and Infrastructure — $6.3 Million

The objective of the community market development and service infrastructure program is to encourage Northern Ontario communities to develop waterfronts, community beautification, theming and tourism signage in support of destination areas.

a) Community Development ($2.3 Million)

This component will include assisting projects with signage, theming, community packaging and special events designed to enhance the tourism competitiveness of Northern Ontario communities.

Implementation
Projects under this program will be implemented and funded by Canada.

Selection Criteria
Assistance will be provided to municipalities and incorporated tourist associations in Northern Ontario and to tourism related businesses.

Projects eligible for funding under other government programs will not normally be eligible for assistance under this program.

Assistance in the form of contributions will be tailored to the needs of the applicant and not exceed 90% of the costs of the project.

b) Community Infrastructure Development ($4 Million)

This component will assist municipalities with capital development of on-shore facilities for waterfront including, sewer, water, power requirements and buildings necessary to improve the area's attractiveness as a tourism destination.

Implementation
Projects under this program will be implemented by the Province.

Selection Criteria
Assistance will be provided to municipalities in Northern Ontario.

Projects eligible for funding under other government programs will not normally be eligible for assistance under this program.

Assistance in the form of contributions will be tailored to the needs of the applicant and not exceed 90% of the costs of the project.

4. Human Resource Development — $1.6 Million

The objective of the human resource development program is to provide assistance for the development and validation of occupational standards for Northern Ontario's tourism industry, develop and deliver awareness programs, and provide assistance for leadership training and training institutions. The Province will be implementing projects through the Ontario Tourism Educational Council.

Implementation
Projects may be implemented under this program by Canada or the Province. Funding may be joint or unilateral. Unilaterally funded projects will be implemented by the party providing the funds. Jointly funded projects may be implemented by either party.

Selection Criteria
Assistance will be provided to partnerships, incorporated associations, corporations, and any other legal entity undertaking an eligible project.

Priority will be given to the development and validation of occupational standards, projects which assist in organizational development and leadership training and projects which encourage the promotion of career awareness programs for the tourism industry in Northern Ontario.

Projects eligible for funding under other government programs will not normally be eligible for assistance under this program.

Assistance in the form of contributions will be tailored to the needs of the applicant.

5. Aboriginal Tourism Development — $0.8 Million

The objective for aboriginal tourism development program is to provide support to Northern Ontario aboriginal entrepreneurs, incorporated associations, and communities through training and organizational development in order to capitalize on tourism opportunities.

Implementation
Projects under this program will be implemented by Canada or the Province. Funding may be joint or unilateral. Unilaterally funded projects will be implemented by the party providing the funds. Jointly funded projects may be implemented by either party.

Selection Criteria

Assistance will be provided primarily to aboriginal entrepreneurs, incorporated associations, and legal entities representative of communities.

Projects may include community based tourism development plans, organizational development and cooperative marketing initiatives aimed at improving tourism in the area.

Projects eligible for funding under other government programs will not normally be eligible for assistance under the program.

Assistance in the form of contributions will be tailored to the needs of the applicant.

6. Communication and Evaluation — $0.8 Million

The objective of this program is to provide communications, evaluation and implementation for Program Schedule "D". The Management Subcommittee will be responsible to approve the overall work plans of both parties, public information activities, the evaluation of cost-shared projects, and general administration. For parallel delivery of project elements which are consistent with the approved work plans, the implementing party will have the responsibility for evaluation and administration. The responsible party for delivery of joint projects will be determined by the Management Subcommittee prior to the initiation of the project.

Program Cost Estimates
For Budgetary Purposes
($ million)

Program	Federal	Provincial	Total
1. Tourism Marketing	2.9	1.0	3.9
2. Database and Market Research Studies			
a) Data Base	-	0.9	0.9
b) Market Research Studies	0.7	-	0.7
3. Community Market Service & Infrastructure			
a) Community Market Development	2.3	-	2.3
b) Community Infrastructure Development	-	4.0	4.0
4. Human Resource Development	0.6	1.0	1.6
5. Aboriginal Tourism Development	0.6	0.2	0.8
6. Communication and Evaluation	0.4	0.4	0.8
TOTAL	**7.5**	**7.5**	**15.0**

Schedule E
Program Cost Estimates
For Budgetary Purposes
($ million)

Forestry	Federal Funds	Provincial Funds	Total
1. Sustainable Forestry Development	16.0	16.0	32.0
2. Aboriginal Forestry	7.0	5.0	12.0
3. Communications, Awareness and Education	1.0	3.0	4.0
4. Management and Evaluation	1.0	1.0	2.0
	25.0	25.0	50.0
Minerals			
1. Geoscience	5.5	3.5	9.0
2. Mining and Minerals Technology	8.0	1.0	9.0
3. Information Transfer & Technology	-	5.5	5.5
4. Exploration Technology	-	2.0	2.0
5. Industrial Minerals/Economic Development	0.5	2.0	2.5
6. Administration/Communications/Evaluation	1.0	1.0	2.0
	15.0	15.0	30.0
Tourism			
1. Tourism Marketing	2.9	1.0	3.9
2. Market Research and Database Studies	0.7	0.9	1.6
3. Community Development	2.3	4.0	6.3
4. Human Resource Development	0.6	1.0	1.6
5. Aboriginal Tourism	0.6	0.2	0.8
6. Communication and Evaluation	0.4	0.4	0.8
	7.5	7.5	15.0
Total	**47.5**	**47.5**	**95.0**

Schedule F
Public Information Procedures

1. The Parties shall cooperate in communication activities relating to this Agreement.

2. Neither Party shall make a public announcement of or relating to any activity funded under this Agreement without the prior consent of the other.

3. A communications subcommittee shall be established for each Program Schedule in accordance with section 4.4(g) to develop a strategic communications plan for the term of this Agreement which will enhance opportunities for appropriate, continuous and consistent recognition for federal-provincial cooperative activities under this Agreement.

4. Each communications subcommittee shall ensure its communication plan is managed and evaluated, and that all media monitoring is maintained. The committee shall be responsible for providing a regular report of public information activities to its Management Subcommittee.

5. A specific promotional communication activity may be delivered by Canada, by Ontario, or jointly, but both Parties shall have reasonable opportunity to review and consent to all details of such activity prior to its delivery.

6. All communication activities shall indicate that the Project or Program is being implemented pursuant to this Agreement and shall reflect each Party's contribution.

7. All reports, news releases, and feature stories arising out of the Communications Plan of this Agreement and initiated by the Parties shall ensure that the public is informed that the activity has been carried out under this Agreement.

8. Any federal-provincial ERDA-related or other identifier or logo that may be agreed upon shall be prominently displayed on all communication material related to this Agreement.

9. All information material produced for or by third parties receiving funding under this Agreement shall clearly and prominently indicate that such funding was provided under the terms of this Agreement and it shall be a condition of such funding that the recipient conform to this clause.

10. All communication material developed or paid for in whole or in part by Canada, undertaken in connection with the Agreement, shall be in both official languages.

GEOLOGY OF FOLEYET AND IVANHOE TOWNSHIPS, NORTHERN SWAYZE GREENSTONE BELT

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INTRODUCTION

A three year project to update the geological mapping database in the northern Swayze greenstone belt was initiated by mapping of Foleyet and Ivanhoe Townships during the 1991 field season. The map area (see Figure 1), situated between latitudes 48° 19'N and longitudes 83°24'W and 83°36'W, was mapped at a scale of 1:15 840. The town of Foleyet is located in the south-eastern part of Foleyet Township about 100 km west of Timmins. Access to the map area is from Highway 101 and associated secondary roads. Funding is provided by the four-year Northern Ontario Development Agreement, a subsidiary agreement to the Canada-Ontario Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario.

Outcrop density is generally low because of extensive glacial till and outwash sand cover. As a result, geological interpretation is also dependent on data from airborne magnetic and electromagnetic surveys (Ontario Department of Mines Geological Survey of Canada 1963a-d; Ontario Geological Survey 1990a-f), information derived from assessment files (Resident Geologist's Office, Timmins) and diamond drill core stored at the Timmins Drill Core Library. Rocks of the Shawmere anorthosite complex in northwestern Foleyet Township were previously mapped at a scale of 1:15 840 (Riccio 1981a, 1981b) and were not included in the current mapping project.

MINERAL EXPLORATION

The following information is derived from the assessment files of the Resident Geologist's Office, Ministry of Northern Development and Mines, Timmins. Recorded past exploration activity has been mainly focused on diamond drill indi-

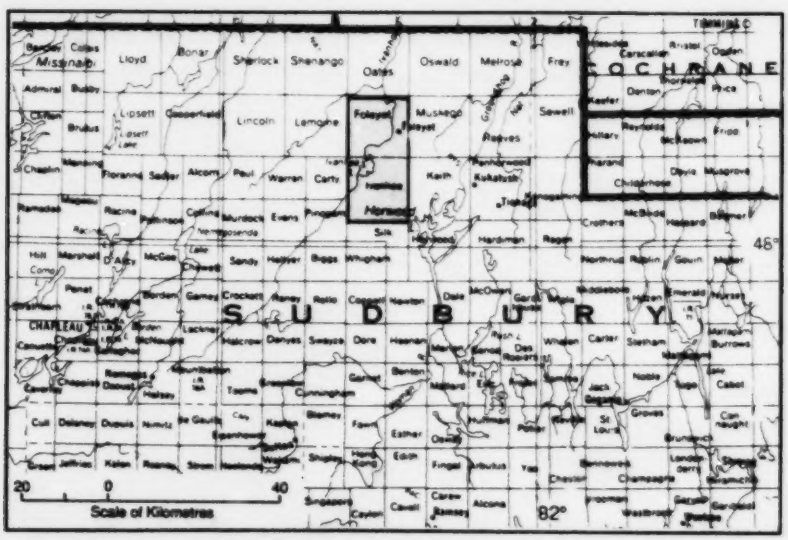

Figure 1. Location of Foleyet and Ivanhoe townships, scale 1:1 584 000

cated, base metal sulphide occurrences and was restricted to south-eastern Foleyet and north-eastern Ivanhoe Townships. This work began in 1964 and continues to the present time. In 1964 and 1965, Keevil Mining Group Limited conducted ground electromagnetic and magnetic surveys, geological mapping and diamond drilled 13 holes totalling 6051 feet (1845 m) in south-eastern Foleyet and north-eastern Ivanhoe Townships. Subeconomic massive to disseminated sulphides comprising pyrite, pyrrhotite and minor sphalerite and chalcopyrite were intersected in several holes. The best assay value was 0.35% Zn and 0.07% Cu over 11.5 feet (3.5m). In 1964 and 1966, International Nickel Company of Canada Limited diamond drilled 7 holes totalling 1052 feet (321 m) in south-eastern Foleyet Township. Minor sulphides were noted but no assay results were filed for assessment. From 1970 to 1972, Noranda Exploration Company Limited conducted ground electromagnetic and magnetic surveys and diamond drilled 2 holes totalling 735 feet (224 m) in southern Foleyet Township. Reported assays indicated only trace base metal and precious metal values. From 1980 to 1983, Hudbay Mining Limited conducted airborne and ground electromagnetic and magnetic surveys and diamond drilled 6 holes totalling 629.8 m in south-eastern Foleyet and north-eastern Ivanhoe Townships. Disseminated to massive sulphides including pyrite, pyrrhotite and minor sphalerite and chalcopyrite occur in several of the holes with the best reported assay being 0.6% Zn over 0.9m.

A total of 85 claims are in good standing in the map area to the end of 1991. Noranda Exploration Limited holds a total of 42 claims in 3 separate groups in south-eastern Foleyet Township and 1 group in south-eastern Ivanhoe Township. Falconbridge Limited holds 35 claims in north-eastern Ivanhoe Township in a group which extends to the east into Keith Township. Cominco Limited has 10 claims in southeastern Foleyet township in 2 groups, one of which extends to the east into Muskego Township. C.M. Kean holds 2 adjacent claims in south-eastern Foleyet Township.

GENERAL GEOLOGY

A 1:63 360 scale geological map by Harding (1937) included all of Ivanhoe and the southern 1/3 of Foleyet Township. A regional scale mapping project at a scale of 1:250 000 by Thurston et al. (1977) included all of the map area. Riccio (1981a, 1981b) mapped the northwestern part of Foleyet Township at a scale of 1:15 840. The map area is also included in a 1:100 000 scale map by Percival (1981).

With the exception of Proterozoic diabase dikes, all rocks are of Archean age. The oldest rocks appear to be the paragneisses and amphibolites metamorphosed to granulate facies rank of the Kapuskasing structural zone in the western part of the map area. They are part of a sedimentary-volcanic succession intruded by the Shawmere anorthosite complex which is in turn intruded by orthogneiss dated at 2765 Ma (Percival 1990). East of the Kapuskasing structural zone, the rocks of the Swayze greenstone belt and associated intrusions have the presumably younger ages of 2715-2700 Ma typical of the "Keewatin-type" supracrustal rocks of the southern Abitibi subprovince (Corfu et al. 1991). These younger supracrustal rocks are metamorphosed to greenschist and amphibolite facies rank. Two lithologically distinct supracrustal assemblages are recognized in the Swayze greenstone belt in the map area. They are called the Muskego-Reeves assemblage

(MRA) and the Horwood Lake assemblage (HLA) (see Figure 2) after the subdivisions established for the Abitibi Subprovince by Jackson and Fyon (in press).

MUSKEGO-REEVES ASSEMBLAGE (MRA)

The MRA is a very diverse lithological succession comprising both volcanic and sedimentary units. The units trend easterly and young to the south. Extrusive rocks are mainly mafic flows with subordinate units of ultramafic flows and felsic to intermediate flows and pyroclastic rocks. Mafic flows are pillowed to massive and locally amygdaloidal. Super cooling textures are common and include varioles and massive mafic flows with spinifex-like acicular mafic and plagioclase crystals in a fine-grained groundmass. Ultramafic flows are talcose and are typically polyhedral jointed to rarely spinifex-textured. Felsic volcanic rocks are feldspar and/or quartz-phyric. They occur as extensively brecciated flows and fragmental units which include both monolithic pyroclastic deposits and heterolithic debris flows. Sedimentary units comprise mainly thickly-to thinly-bedded wackes and feldspar-phyric tuffaceous wackes. Thickly-bedded conglomerates contain poorly-sorted, subangular, heterolithic volcanic and subvolcanic intrusive clasts. Where exposed in outcrop along the Ivanhoe River in Foleyet Township, they are extremely thickly bedded and normally graded with rare massive sulphide clasts consisting of pyrrhotite and minor chalcopyrite. Here the conglomerates are intimately interbedded with ultramafic flows and graphitic mudstones. Thin to thickly-bedded magnetite-chert ironstone interbedded with ultramafic and mafic volcanic was observed in core and reported in diamond drill logs in the northern part of the MRA in south-eastern Foleyet Township (see Figure 2). An aeromagnetic anomaly is associated with this unit and extends from south of the Canadian National Railway rail line at the Muskego-Foleyet Township boundary to just east of Highway 101 (Ontario Geological Survey 1990a-f).

HORWOOD LAKE ASSEMBLAGE (HLA)

The southern part of the Swayze greenstone belt in the map area is underlain by the HLA. The assemblage comprises monotonous mafic volcanic flows which differ from those of the MRA principally in their lack of intercalations of ultramafic volcanic rocks, felsic volcanic rocks or sedimentary rocks and the presence of extensive gabbroic bodies (see Figure 2). The boundary between the MRA and the HLA is the Muskego River fault which also delineates an abrupt transition from greenschist facies rocks to the north into amphibolite facies rocks to the south. Mafic volcanic rocks of the HLA are amphibolitized and commonly garnitiferous. Pillow selvages, varioles and amygdules are locally evident. Where preserved, pillow tops indicate consistent facing to the south-west. Near the south-central margin of the map area, the garnetiferous, amphibolitized mafic flows contain rounded epidote-rich pods averaging 10-20 cm, which can comprise up to 50% of the rock.

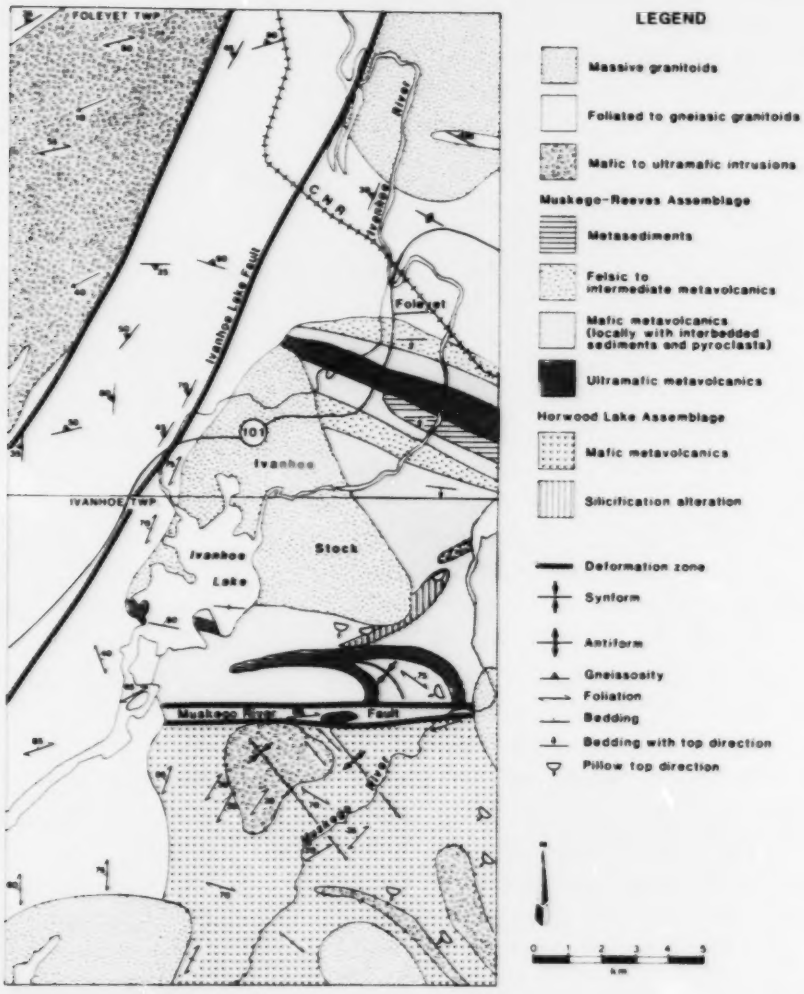

Figure 2. General geology of Foleyet and Ivanhoe townships

SYNVOLCANIC INTRUSIONS

Lenticular bodies of mainly gabbro, with minor leucogabbro, melagabbro and pyroxenite occur within both the MRA and HLA supracrustal sequences. Locally cross-cutting contacts indicate that at least some of these bodies are intrusions. However, the compositional and textural similarity with the volcanic rocks strongly suggest they are synvolcanic and some may in fact be large massive flows. As mentioned previously gabbroic bodies are more extensive in the HLA. These are sill-like in their relationship with the associated mafic volcanic rocks. The map pattern of the irregular shaped gabbro in the central part of Ivanhoe Township (see Figure 2) might normally suggest a plug-like intrusion. However, it also is a sill-like body which is gently-dipping to the east and has been folded in the nose of a shallow south-east plunging synform.

PRETECTONIC GRANITIC INTRUSIONS

Much of Foleyet Township and the west part of Ivanhoe Township are underlain by gneissic-textured to strongly foliated granitic intrusions. West of the Ivanhoe Lake fault (see Figure 2) the gneisses of the Kapuskasing structural zone are compositionally variable consisting mainly of tonalite and granodiorite. The

tonalite gneiss commonly contains abundant amphibolite xenoliths and in the northern part of Foleyet Township amphibolite gneiss is more abundant than tonalite gneiss. Minor quartz undersaturated phases comprising diorite and monzonite gneiss occur adjacent to the Shawmere anorthosite complex in south-western Foleyet Township. East of the Ivanhoe Lake fault, the pretectonic intrusions surround the Swayze greenstone belt to the north and west. In the north-eastern part of Foleyet Township the gneisses are predominantly tonalities with inclusion of paragneiss and amphibolite. In Ivanhoe Township, the early granitic intrusions are less deformed, ranging from moderately to weakly foliated. Compositions are highly variable and include tonalite, granodiorite, granite and a narrow body of alkalic affinity extending from along the Ivanhoe Lake fault in southern Foleyet Township about 10 km to the south-east, into west central Ivanhoe Township. Alkalic phases include monzonite, syenite, syenodiorite and diorite. Abundant xenoliths of hornblende-biotite gabbro, hornblendite and pyroxenite occur locally within this alkalic intrusion.

POST-TECTONIC GRANITIC INTRUSIONS

Massive, unfoliated granitic instrusions are restricted to east of the Ivanhoe Lake fault. These intrusions tend to be more potassic than the pretectonic granitoids. Compositions are predominantly granite and granodiorite with or without tabular alkali feldspar phenocrysts. Both of the intrusions in the north-east and south-west corners of the map area are granites extensively invaded by pegmatites with graphic-textured intergrowths of perthite and quartz. The Ivanhoe Lake stock is predominantly granodiorite in the west and quartz monzodiorite in the east. The stock has a zircon U-Pb date of 2680 +3/-2 Ma supporting a late, post-tectonic, crystallization age (Percival and Krogh 1983).

STRUCTURAL GEOLOGY

Kapuskasing Structural Zone

Throughout the Kapuskasing structural zone, gneissosities generally dip moderately to the north-west. Mineral lineations and small scale folds in gneissosity have shallow plunges to the south-west. Two north-west-trending late faults occur in the zone. The western fault lies along the eastern margin of the Shawmere anorthosite complex and was previously recognized by Riccio (1981a, 1981b). It is characterized by numerous "veinlets" of black, aphanitic pseudotachylite and mylonite. These cataclastic zones range up to several centimetres thick, and are extremely variable in orientation cross-cutting the gneissosity. The eastern fault has been identified as the Ivanhoe Lake fault and is considered to be the boundary between the Kapuskasing structural zone and the Abitibi Subprovince (Percival 1990). In the map area, the Ivanhoe Lake fault is characterised by augen-textured monzonite gneiss exposed along the old channel of the Ivanhoe River north of Highway 101. The monzonite gneiss has shallow, west-plunging, stretching lineations and gently south-east plunging folds in the gneissosity with asymmetry indicating south-east directed thrusting along the fault zone.

North Swayze Structural Zone

East of the Kapuskasing zone the gneissosities are more variable in trend and are generally parallel to the S1 foliations in the adjacent supracrustal rocks of the Swayze greenstone belt suggesting a cogenetic structural evolution. There is evidence for at least three

deformational episodes in the supracrustal rocks. An S1 foliation or cleavage is evident in most supracrustal outcrops as a flattening fabric which is generally subparallel to stratigraphy. S2 is evident as variably developed steeply-dipping cleavage crenulating the S1 fabric or axial planar to upright F2 folds in the S1 fabric. D3 has a relatively minor expression in the map area as shallow dipping crenulations and kink bands cross-cutting the S1 and S2 fabric.

Evidence for F1 folds are scarce as a result of the general lack of outcrop and top indicators. A fold in an ultramafic volcanic unit (partially inferred from aeromagnetic data) appears to represent an F1 fold in the southern part of the MRA (see Figure 2). S1 foliations are quite variable in orientation in the HLA as a result of F2 folding. In many places the S1 foliation has much shallower dips in the amphibolites of the HLA in contrast to the consistently steep dips of S1 foliations in the greenschist facies rocks of the MRA. F2 megascopic folds re-orient S1 foliations in an upright synform-antiform pair with north-west-trending axial traces in the northern part of the HLA. Associated F2 minor fold axes and L2 lineations change in orientation from shallow south-east plunges north of the Muskego River to shallow north-west plunges south of the river.

The Muskego River fault is a broad east-trending deformation zone comprising variably schistose and carbonatized rocks. The fault separates the MRA and HLA terrains. South side up displacement is indicated by the transition from greenschist to amphibolite facies rank across the fault. However, dextral strike-slip displacement is also suggested by the re-orientation and truncation of the limbs of the F1 fold in the southern margin of the MRA (see Figure2)

ECONOMIC GEOLOGY

The map area is considered by the author to have good potential for volcanogenic massive sulphides within the MRA in the northern part of the Swayze greenstone belt. This potential is indicted by several diamond drill intersections of subeconomic stratabound massive sulphides and widespread hydrothermal alteration including silicification and chloritoid-bearing volcanic rocks. An extensive silicification zone occurs in mafic volcanic rocks in north-eastern Ivanhoe Township cut by the south-eastern margin of the Ivanhoe Lake stock (see Figure 2) The silicification is controlled by the original porosity of the volcanics. This is seen in the extensive alteration of highly amygdaloidal flows and hyaloclastites closely associated with relatively unaltered non-amygdaloidal and unbrecciated pillowed and massive flows. Chloritoid porphyroblasts occur in carbonatized mafic volcanic rocks underlying a subeconomic stratabound massive sulphide horizon in a diamond drill hole in south-eastern Foleyet Township (Hole F82-5, Timmins Assessment file # T-2430; Timmins Drill Core Library # T10497) and was also observed in outcrops of carbonatized felsic volcanic rocks along the Ivanhoe River 1.4 km along strike, east of the drill hole collar. It is worthy of note that similar-appearing silicification zones and chloritoid-bearing altered volcanic rocks are associated with a number of Archean volcanogenic massive sulphide deposits (e.g.. Gibson et al. 1983; Franklin et al. 1975)

Gold potential may exist associated with easterly-trending carbonatized shear zones such as the Muskego River fault. The Keith-Penhorwood deformation zone, along strike with the Muskego River fault

to the easthosts gold mineralization at the Joburke Mine and a number of other gold prospects (Siragusa 1990)

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GEOLOGY AND MINERAL POTENTIAL OF MOSS TOWNSHIP, SHEBANDOWAN GREENSTONE BELT, DISTRICT OF THUNDER BAY, ONTARIO

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INTRODUCTION

This is the first year of a three year mapping project of the west-central Shebandowan greenstone belt, an area of Archean Supracrustal rocks which form part of the Wawa subprovince in northwestern Ontario. This project is jointly funded by the four-year Northern Ontario Development Agreement, a subsidary agreement to the Canada-Ontario Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario. The purpose of the project is to update and expand the geological data base and to evaluate mineralization potential.

The map area (Figure 1) consists of all of Moss Township, covering approximately 210 km2, and is bounded by longitudes 90° 39'29"W and latitudes 48°29'60"N and 48°36'46"N.

Access to the map area is by Highway 11 west from Thunder Bay to the village of Kashabowie and from there, several gravel roads lead into the map area. Alternate means of access would be by float or ski-equipped aircraft to Moss, Fountain and Burchell Lakes.

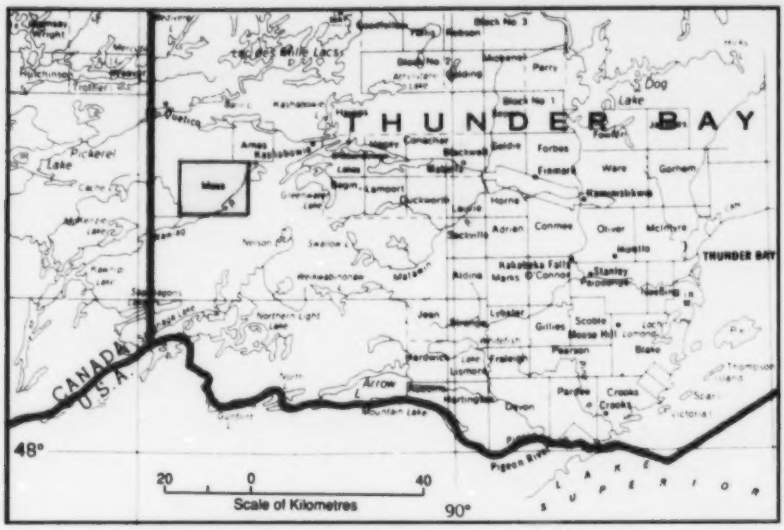


Figure 1. Location map of study area, scale 1:1 584 000

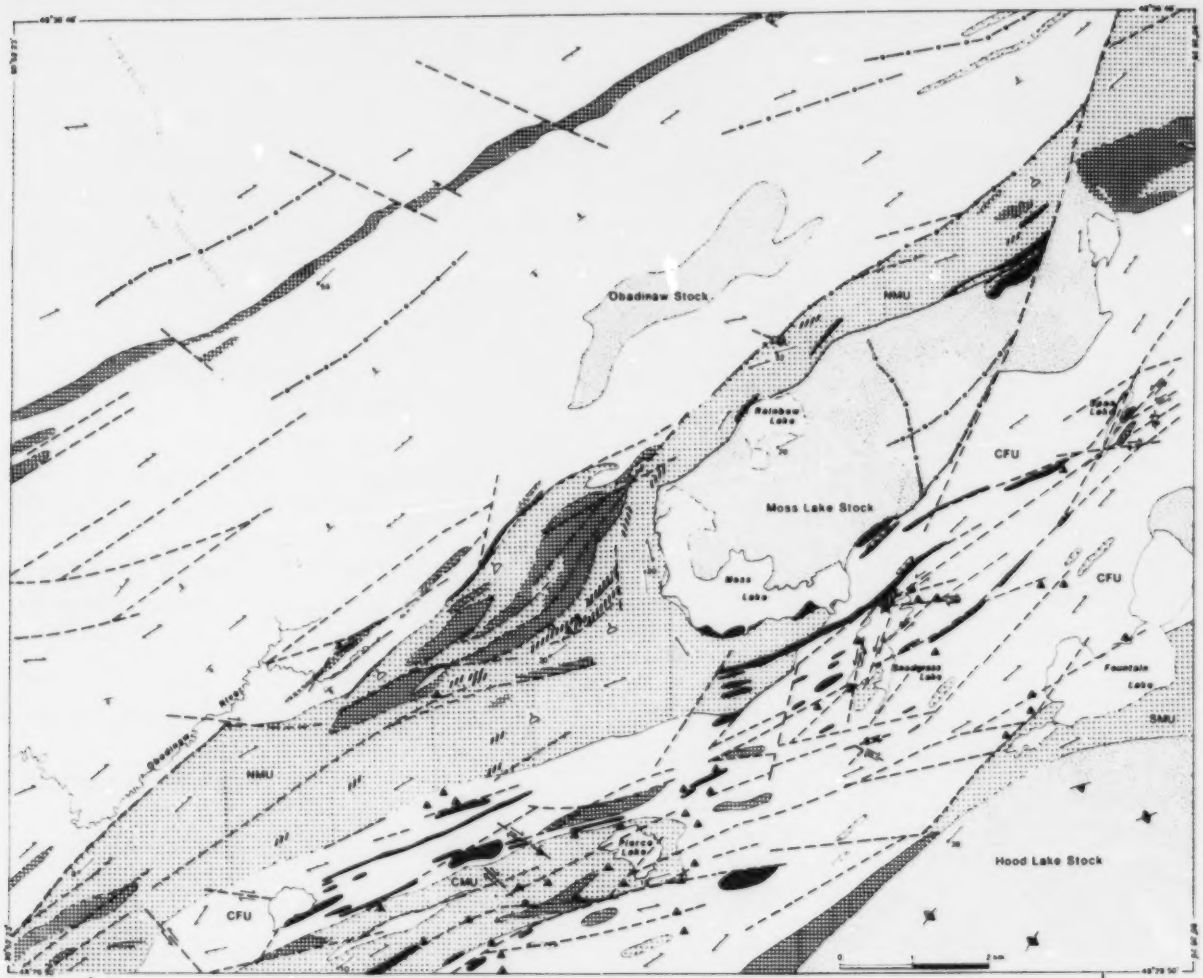
Preliminary findings are summarized in this report and a preliminary map based on this survey will be released early in 1992.

MINERAL EXPLORATION HISTORY

The map area contains one past-producing gold mine which operated intermittently from 1875-1936, under the names of Jackfish, Huronian, Moss, Kerry and Arden mines (Harris 1970). The earliest exploration activity, which led to the discovery of the mine, dates back to 1871. At that time a sample of auriferous quartz vein was collected by trappers J. Baptiste and M. Douchette. Shortly after, the area was explored by pits and trenches and a one-ton sample was tested, which yielded $36.20 in gold (gold at $20.67 per ounce) and $12.98 silver (Harris 1970). From 1932 to 1936 and in 1942 total production from the mine was 29 948 ounces of gold and 172 376 ounces silver from 143 724 tons of ore milled (Harris 1968).

In 1957, Noranda Inc. optioned the Huronian Mine property and carried out geological and geophysical surveys. Conductive zones were drilled. These conductive zones were found to be caused by graphitic schists containing pyrite and pyrrhotite (Harris 1970, Geological Data Inventory Folio (GDIF), Resident Geologist's Office, Thunder Bay).

A gold prospect north of Snodgrass Lake was initially explored by The Mining Corporation of Canada Limited in 1936 when 7 trenches were dug. During 1983-1987, the Snodgrass Lake property and adjacent areas were extensively drilled by Tandem Resources Limited. Approximately 54 864 m of surface and 1524 m of underground drilling were carried out during this period (Canadian Mines Handbook, 1991-1992). Also 1005 m of underground opening, and 275 m of drifting was done at the 200-foot level during this period. In 1989, the property was optioned to Central Crude Limited (Canadian Mines Handbook, 1991-1992). Under this agreement, Central Crude Limited agreed to spend $6.5 million on exploration on the property. Noranda Exploration Company Limited, the project operator, is also an indirect major shareholder of Central Crude's issued and outstanding common shares (Lavigne et al. 1990). Approximately 5977 m of drilling was carried out



LEGEND

PROTEROZOIC

- Diabase dike

ARCHEAN

- Felsic intrusive rocks (Syenite and related intrusive rocks)
- Younger metasedimentary rocks
- Mafic to intermediate intrusive rocks
- Metasedimentary rocks (Quetico-type)
- Chemical metasedimentary rocks (Iron formation)
- Felsic to intermediate metavolcanic rocks
- Mafic to intermediate metavolcanic rocks
- Feldspar porphry

SYMBOLS

- Gold prospect
- Gold occurrence
- Past producer
- Pillow, top indicated by arrow
- Bedding, top indicated by arrow
- Bedding, parallel to foliation
- Foliation
- Lineation with plunge
- Shear/Fault zone
- Lineament

Figure 2. General bedrock and structural geology of Moss Township. The distribution of gold occurrences is also shown. Abbreviations are: NMU = Northern mafic to intermediate metavolcanic unit; CMU = Central mafic to intermediate metavolcanic unit; SMU = Southern mafic to intermediate metavolcanic unit; and CFU = Central felsic to intermediate metavolcanic unit.

during 1989-1990 by Central Crude Limited (Lavigne et al. 1990). An ore reserve of 65.5 million tons grading 0.032 ounce Au per ton is reported for the prospect (Canadian Mines Handbook, 1991-1992).

Several gold occurences exist within the map area (see Figure 2) and they are recorded in the Resident Geologist's Office in Thunder Bay, Ontario.

PREVIOUS WORK

The present map area was originally mapped by Watson (1928) at a reconnaissance scale and later by Harris (1970) at 1 inch to 1/2 mile. Giblin (1964) mapped part of the eastern Moss Township at a scale of 1 inch to 1/4 mile. Recently, Chorlton (1987) did mapping and detailed studies on the setting of gold mineralization in the Huronian Mine and Snodgrass Lake areas.

GENERAL GEOLOGY

All rocks, except diabase dikes, are Archean in age (Corfu and Stott 1986). The map area includes part of the western Shebandowan greenstone belt of the Wawa Subprovince and metasedimentary rocks of the Quetico Subprovince. The Shebandowan belt is an arcuate supracrustal mass which forms the northern margin of the Wawa Subprovince in northwestern Ontario. The greenstone belt is bounded to the north by the metasedimentary rocks and associated granitic intrusions of the Quetico Subprovince and to the south by a granitoid batholithic complex (Ontario Geological Survey 1991a). To the north, the contact with the Quetico metasedimentary rocks is both conformable and fault-bounded (Giblin 1964; Harris 1970; Stott 1985).

Within the study area, the Shebandowan greenstone belt is bounded to the northwest by metasedimentary rocks of the Quetico Subprovince. The northern contact of the belt with the metasedimentary rocks, where exposed, is sheared; elsewhere the contact zone is underlain by regional topographic linear features.

The Shebandowan belt, within the study area, is chiefly comprised of mafic to felsic metavolcanic units, which have been intruded by numerous syn-to post-tectonic mafic to felsic intrusive rocks. The metavolcanic rocks of the belt, in general, form a homoclinal, north-younging sequence. The supracrustal rocks are informally subdivided into four units, namely; 1) a northern mafic to intermediate metavolcanic unit; 2) a southern mafic to intermediate metavolcanic unit; 3) a central felsic to intermediate metavolcanic unit; and 4) a central mafic to intermediate metavolcanic unit.

Narrow slivers (from a few metres up to 2 km long) of mafic metavolcanics are also found within the Quetico metasedimentary belt.

NORTHERN MAFIC TO INTERMEDIATE METAVOLCANIC UNIT

The northern mafic to intermediate metavolcanic unit (NMU) extends from the southwest for about 20 km to the northeast extremity of Moss Township (see Figure 2). The thickest (3.5 km) part of this metavolcanic unit is centred immediately southwest of Moss Lake. It is bounded to the northwest by the Quetico metasedimentary belt and to the southeast by felsic to intermediate metavolcanics and the Moss Lake Syenite Stock.

The NMU is chiefly comprised of massive and pillowed flows with associated pillow breccia and fragmental rocks. Pillowed flows and pillow breccia predominate in the northeast and massive flows, with subordinate pillowed lava and fragmental rocks, are dominant in the southwestern part of the NMU. The fragmental rocks consist of block to lapilli-size, subangular- to oval-shaped monolithic fragments of pillowed lava in a matrix of basaltic hyaloclastite. Intact pillows and amygdular or vesicular fragments and exotic chert clasts in the Huronian Mine and Beaver Pond areas suggest that these rocks are possibly subaqueous debris flows. The unit, in general, displays poor sorting. However, portions of this unit are noted, in places, to be well sorted, from block to ash size over 15 to 20 m of stratigraphic thickness and appear to mark individual smaller debris flows. Some of these fragmental rocks may possibly represent in situ pillow breccia set in a hyaloclastite tuff. The fragmental rocks in the Huronian Mine area are noted to overlie pillowed flows and pillow breccia. The gradation from pillow breccia to fragmental rocks is very subtle and distinction between them is commonly difficult.

The mafic metavolcanic rocks extending from west of Moss Lake to the northeastern extremity of the map area are highly tectonized and recrystallized; therefore, in many places they can only be identified as amphibole-plagioclase schist or amphibolite. These metavolcanic rocks are bounded by the Moss Lake Stock, to the southeast, and are juxtaposed to the northwest by the Quetico metasediments. The contact zone is sheared in many places. However, well-preserved, pillowed and massive flows in a few places along the length of the unit confirm the mafic volcanic protolith for rocks in the northeastern NMU. The NMU is intruded by numerous large and small mafic to intermediate sills and dikes. Metre scale lenses of felsic metavolcanic rocks occur in the northeastern half of the NMU.

SOUTHERN MAFIC TO INTERMEDIATE METAVOLCANIC UNIT

The southern mafic to intermediate metavolcanic unit (SMU) occurs as a narrow belt in the southeastern part of the township (see Figure 2). The belt is bounded to the north by felsic to intermediate metavolcanic rocks and to the south by the Hood Lake Syenite Stock. The SMU is chiefly comprised of massive mafic flows and mafic gneisses. Pillowed flows and fragmental rocks are apparently absent in the SMU. Mafic gneiss occurs along the contact. The gneiss consists of alternating hornblende and plagioclase bands up to 2.5 cm thick. Adjacent to the contact with the stock, hornblende is porphyroblastic. The porphyroblasts are 1 to 2 mm in size and occur parallel to and crosscut the layering. Gneissic layering becomes less developed outward from the intrusive contact with the stock and gradually merges with the fine-grained, massive mafic flows. The mafic gneiss, which represents amphibolite grade metamorphic facies is a contact metamorphic aureole imposed upon greenschist-grade mafic metavolcanic rocks by the Hood Lake Syenite Stock.

CENTRAL MAFIC TO INTERMEDIATE METAVOLCANIC UNIT

The central mafic to intermediate metavolcanic unit (CMU) is a northeast-trending, approximately 1 km wide wedge, extending from the south-central township border to Pierce Lake (see Figure 2). The CMU is chiefly comprised

of massive and pillowed flow units with associated pillow breccia and fragmental rocks. Along the strike, a small lens of strongly silicified, massive to pillowed flows and fragmental units containing iron formation occur in the Snodgrass Lake area. The source for fragmental rocks is interpreted to be similar to that of the NMU fragmental rocks.

CENTRAL FELSIC TO INTERMEDIATE METAVOLCANIC UNIT

The central felsic to intermediate metavolcanic unit (CFU) extends from the southern township boundary through north and south of Pierce Lake to Snodgrass Lake, swinging east-northeast towards Span and Fountain lakes, and finally to Burchell Lake in the northeastern part of the township (see Figure 2). The CFU has a mafic to intermediate metavolcanic wedge in the southern part of the township and narrow small lenses occur throughout the CFU.

The CFU is chiefly comprised of massive and porphyritic flows and associated flow breccias (autoclastic) of similar composition (dacite and rhyodacite). Coarse fragmental rocks are abundant east of Pierce Lake and are traceable to the Snodgrass Lake area. Small lenses of fragmental rocks also occur south of Wawiag River and on the north shore of Fountain Lake. Blocks of angular to subangular flow material occur in an aphanitic and well-sericitized +_ chloritized and foliated groundmass. Block- to lapilli- size fragments make up 5% to 40% of the rock volume. Frequently, block- and lapilli size material can be seen to represent proximal- to vent- facies flows and associated explosive breccias.

CHEMICAL METASEDIMENTARY ROCKS

Iron formation and minor chert beds are commonly found in the mafic to intermediate metavolcanic succession. Two types of iron formation are found in the map area: 1) thinly bedded alternating chert + magnetite-banded iron formation; 2) a rare fragmental iron formation unit comprising clasts of chert, magnetite and mafic metavolcanic rocks, in a carbonate-enriched clastic matrix, which occurs locally in the Huronian Mine area and west of Moss Lake. The clasts vary from granule to boulder size. The larger fragments are generally vesicular mafic metavolcanic rocks. The fragmental iron formation is likely derived from underlying vesicular or amygdaloidal massive and pillowed mafic flows and chert-magentite-banded iron information.

Alternatively, the fragmental iron formation may have been formed by tectonic processes. In the Huronian Mine area, the fragmental iron formation is exposed in the closely spaced high-strain zones and, as a result, iron formation is boudinaged, tightly drag folded and sheared. The shearing and tight drag folding of competent chert-magnetite beds along with less competent mafic to intermediate metavolcanic rocks may have been responsible for the fragmentation of iron formation.

QUETICO METASEDIMENTARY ROCKS

The northeast-trending Quetico Subprovince metasedimentary rocks consist of massive to thinly bedded, weakly graded, wacke and minor, thinly bedded to finely laminated siltstone. The wacke is generally comprised of quartz,

mica and lithic fragments. Siltstones are well sorted and consist of plagioclase and minor quartz grains.

The Quetico metasedimentary rocks contain rare planar cross-beds and are weakly graded. Commonly, wacke beds grade from fine grained to silt size. Silty tops of the beds are in sharp contrast with the overlying wacke beds. Tops are dominantly northward but reversals are common and indicate the presence of minor and major folds. Top determinations from the southwest township boundary indicate that the Quetico metasedimentary rocks face south at the contact with the north facing Shebandowan metavolcanic unit (NMU).

Dikes and sills of several types transect the Quetico metasedimentary rocks. Feldspar porphyritic-diorite, diorite, leucogabbro, gabbro, feldspar porphyry and trondjhemite intrude along bedding planes. Late diabase dikes crosscut bedding at several locations.

MAFIC TO INTERMEDIATE INTRUSIVE ROCKS

Mafic to intermediate intrusive rocks include gabbro, leucogabbro, diorite, feldspar porphyries and related altered equivalents. Most of these intrusive rocks occur as sills but cross-cutting dikes of all types are common. In large outcrops, gradation from gabbro to feldspar porphyry is commonly noted. No compositional layering was observed. The gradation from mafic gabbro to intermediate feldspar porhyry indicates possibly a similar source of origin for these rock types.

Gabbro is the dominant intrusive rock in the NMU and the Quetico metasedimentary rocks. Diorite and associated feldspar porphyries are the most common intrusive rocks in the central felsic to intermediate metavolcanic host. A moderately magnetic, metamorphosed, mafic to intermediate intrusive body (see Figure 2) was mapped northwest of Burchell Lake where it has intruded the mafic metavolcanic rocks. The main rock types within this intrusive body include gabbro, plagioclase-phyric gabbro, amphibolite and diorite. Some of these intrusive rocks could possibly be coarse mafic flows. No compositional layering or gradation were observed on outcrop scale. Disseminations of sulphidemineralization (chalcopyrite and pyrite) was noted in a few outcrops.

YOUNGER METASEDIMENTARY ROCKS

A few small exposures of conglomerate occur in the vicinity of the Minoletti trenches on the Nelson Lake Road. The conglomerate is polymictic, clast supported and contains subangular to subrounded clasts of felsic and mafic metavolcanic rocks and feldspar porphyry. Small amounts of pink latite also occur in some rocks. The clasts are cobble to boulder in size. In addition to this polymictic conglomerate outcrop, the present field party discovered additional small exposures along strike. The oligomictic paraconglomerate is pale grey on a fresh surface and weathers whitish grey. About 10% rounded to subrounded pebble-size clasts of presently unknown material are set in a fine-grained greyish, immature matrix. The conglomerate is schistose and parallels the 70° striking shear zone in the area.

FELSIC INTRUSIVE ROCKS (SYENITE AND RELATED ROCKS)

Three syenitic stocks, the Moss Lake, Hood Lake and Obadinaw stocks occur in the map area. The Moss Lake Stock is a composite intrusive body which extends northeast for approximately 7.5 km from

the south shore of Moss Lake. The stock is up to 2.3 km wide and is elongated along strike. The stock ranges from true syenite to granite (greater than 20% quartz). Hornblende syenite is the most common rock type within the stock with rare biotite syenite. The syenite and related rocks are generally medium-grained, but fine grained, megacrystic phases and layered phases are also present. Numerous xenoliths of country rocks occur ranging in size from 10 cm to 20 m. The layered unit consits of hornblende-rich bands up to 5 cm thick, interlayered with potassium feldspar rich bands. Fluorite is found in several localities, most notably on Spruce Island of Moss Lake. Up to 3% magnetite occurs throughout the stock. The magnetite content of the stock is reflected by a relatively high magnetic signature (OGS 1991b). Disseminated pyrite is found in some localities.

The Hood Lake Stock is circular and lies south-southwest of Fountain Lake. Only the northwest portion of the stock is within the map area. The syenite of the stock is characteristically megacrystic hornblende+_pyroxene syenite with up to 20% biotite in some instances. Feldspar megacrysts from 0.5 cm to 10 cm long and up to 4 cm across make up between 60% to 80% of the rock volume. The megacrysts are generally aligned to the regional strike. Hornblende+_pyroxene is found interstitial to the feldspar megacrysts. The syenite along the contact with the southern mafic to intermediate metavolcanic rocks is gneissic (augen-gneiss).

Up to 5% magnetite is common throughout the stock. Pyrite is found as disseminated grains in the syenite in several localities. The Hood Lake syenite was emplaced along major fault planes in the metavolcanic rocks of the Wawa Subprovince and because of its relatively undeformed nature, it was probabaly emplaced after most of the regional deformation had already taken place (Schwerdtner 1986).

The Obadinaw Stock differs from the Moss Lake and Hood Lake syenite stocks in that it ranges from a feldspar porphyritic syenite with less than 5% hornblende megacrysts to a hornblende porphyritic syenite with up to 90% hornblende. The phenocrysts are, on average, 1 cm long. Another melanocratic phase of the Obadinaw Stock is a biotite-rich syenite.

Pegmatitic patches and veins of potassium-feldspar are found in the syenite and the surrounding metasedimentary rock. Feldspar crystals in veins measure up to 7 cm long and 3 cm across. Numerous syenite dikes cut the surrounding metasedimentary rocks and are probably offshoots of the main stock. These dikes contain up to 10% muscovite and are thought to have derived from the partial melting of the metasedimentary host rocks.

Very little quartz is noted in the Obadinaw Stock. Magnetite occurs in patches and makes up to 5% of the rock volume.

Metasedimentary inclusions occur in the stock and are recrystallized. The recrystallized inclusions are similar to the metasediments which surround the stock.

The Obadinaw Stock also appears to be emplaced along zones of weakness similar to those controlling emplacement of the Moss Lake and Hood Lake syenite stocks.

DIABASE DIKES

Diabase dikes are the youngest intrusive rocks in the map area. They intrude all major rock types. The dominant trend of these dikes is north to northwest; rare east-striking dikes also occur. The diabase dikes are reddish brown on the weathered surface and light to dark grey on fresh surface. They are finegrained to aphanitic. The texture is generally diabasic with feldspar (plagioclase) laths less than 1 mm. They contain up to 10% magnetite. The dikes are unfoliated. To the west and northwest of the map area, the northwest-trending dikes, reported here, may be part of a Keweenawan dike swarm (1.1 Ga; Osmani, in press). No radiometric data is available for the dikes within the map area.

METAMORPHISM

The bulk of the Shebandowan metavolcanic rocks have been metamorphosed to lower greenschist facies. Mafic metavolcanic rocks contain chlorite and albite while the felsic metavolcanic rocks contain chlorite and sericite.

Metamorphic grade within the Shebandowan metavolcanic rocks increases proximal to the large syenite stocks (Moss Lake and Hood Lake). Mafic metavolcanic rocks proximal to these stocks are banded and hornblende porphyroblastic. They contain a dark green to black hornblende and plagioclase assemblage, reflecting the amphibolite-grade contact metamorphic aureole imposed during the emplacement of the syenite stocks. In the northeastern portion of the NMU, brown-red garnet was also noted in an outcrop, approximately 400 m from the contact of the Moss Lake Stock.

Quetico metasediments display recrystallized textures and a well-developed foliation defined by biotite orientation proximal to these large intrusions.

In the extreme northwest of the map area, granite and trondhjemite dikes are abundant. Recrystallization in metasedimentary rocks similar to that noted near the syenite stocks, increases in prominence to the northwest. Approximately 3 km north of the northwest township boundary, Harris (1970) has mapped migmatites.

STRUCTURAL GEOLOGY

Primary Structure

Bedding in the Quetico metasedimentary belt generally strikes northeast and dips steeply to the northwest. Minor dip reversals are also noted. Stratigraphic younging directions determined from graded bedding in the Quetico metasediments generally young northward; however, southward younging is also observed in many places, more specifically closer to the contact of the Quetico metasediments with the NMU towards the western part of the township. Tops determined from pillows and the architecture of individual flow units in the NMU and CFU suggest stratigraphic younging to the north.

In the western part of the township, Quetico metasediments face southward near the contact with the NMU. The NMU in that area generally faces northward. The opposing facing directions of the Quetico metasediments and the NMU probably suggest tectonic juxtaposition of unrelated sequences along the faulted contact.

Folding in the Quetico metasediments appears to be isoclinal with thickened hinge areas and attenuated and truncated limbs on an outcrop scale. Fold closures occur on a small scale with changes in

bedding attitudes taking place over a few metres. Numerous isoclinal folds of S, Z and M symmetry are common in the Quetico metasediments and to a lesser extent in the NMU. Boudinage and pinch and swell structures are common in the Quetico metasediments and less common in the NMU. These features may indicate limb attenuation associated with the isoclinal folding.

FOLIATION AND LINEATION

Pervasive foliation and lineation are present proximal to the major shear zones and topographic lineaments. The foliation is less well developed outward from these zones and the lineation disappears. Chlorite and sericite mineral lineations in schistosity planes show shallow plunges (5° to 30°) to the southwest. Rare examples of northeast plunge also exist. Crosscutting mineral lineations are also noted in a few places. For example, on the island on Snodgrass Lake, a late shear-related mineral lineation crosscuts an earlier subhorizontally plunging (5°) mineral lineation. Movement on the shears is sinistral and marked by tails of rotated fragments.

SHEAR AND FAULT ZONES

The predominant structural imprint in the map area is numerous northeast to east-northeast-striking (40° to 70°), steeply dipping, ductile to brittle shear and fault zones. Many of these observed structures are coincident with topographic lineaments. Late shear and brittle faults trending northwest, east and north are also common, but they are less extensive compared to northeast-striking shear zones. The northeasterly-striking shear zones with sinistral sense of movement, are locally offset dextrally by east, northwest and north-trending brittle shear fractures and faults. On outcrop scale, these structures are of variable orientation and appear to be a conjugate shear/fault system. Many of these structures are spatially associated with gold mineralization in the map area, (e.g., Snodgrass Lake Prospect (Chorlton 1987) and Span Lake gold showing).

Many large-scale, anastomosing shear zones can be traced for several kilometres on recently released airborne magnetic and electromagnetic maps (OGS 1991b). The shear zones on these maps are marked by long, linear zones of low to medium magnetic intensities and some of them are coincident with trains of weak to medium strength electromagnetic conductors. These conductive zones may have the potential of hosting base-metal and gold mineralization. The best example of the shear/fault system exists in the southern part of the township, where many of these structures can be traced for several kilometres to the Snodgrass and Span Lake areas. These and many other structures in the map area are good regional targets for gold and base-metal mineralization.

ECONOMIC GEOLOGY

Some general observations of the field relations in key outcrops are discussed below.

In the Span Lake area, at the Central Crude Limited-INCO Limited gold showing, a pink (feldspathized?), sericitized host rock (felsic porphyritic flow?) is intruded by feldspar porphyritic and equigranular diorite. Felsic metavolcanic rock and diorite are cut by northeast (40° to 50°) and east-northeast (60° to70°) striking, steeply dipping, ductile to brittle, curvilinear shear zones. The felsic volcanic rock, where cut by the shear zone, is altered to quartz + sericite +_ chlorite

schist. The sericitized schist subtly passes into a strongly feldspathized portion of the outcrop. The feldspathized rock strongly resembles syenitic intrusions in the area. Sulphides (chalcopyrite and pyrite) occur in the feldspathized rock along fracture/shear planes and also disseminated throughout the rock. Occasional mafic clots (amphibole phenocrysts now altered to chlorite?) also contain sulphides. In quartz+ sericite+_ chlorite schist, the sulphides occur along shear planes as narrow massive seams. Diorite, where cut by shear zones, is rusty and contains sulphides along shear planes.

Similar alteration types, lithologic packages and structures are also observed at the Snodgrass Lake prospect of the Tandem Resources-Storimin Exploration Limited-Central Crude Limited. At Snodgrass Lake, the feldspar porphyry and diorite intrude felsic metavolcanic rocks. A small hornblende-quartz-syenite intrusion cuts both the diorite and felsic metavolcanic rocks. These rocks are traversed by northeast (40°) to east-northeast (60° to 75°) striking, steeply dipping fissile shear zones. Late brittle faults and fracture sets of variable orientation cut earlier shear zones. The felsic metavolcanic rock is sericitized and sulphidized along shear planes. Diorite shows epidotization and silicification and it is schistose in places. Disseminated pyrite and chalcopyrite occur in shears and associated fractures in diorite. The syenite intrusion is also cut by east-northeast-trending shear zones. Altered amphibole (chlorite?) phenocrysts in syenite are associated with fine-grained pyrite and chalcopyrite.

At the Snodgrass Lake prospect, gold values of up to 1650 ppb and 370 ppb have been reported (Chorlton 1987) from highly sheared/fractured diorite and felsic metavolcanic rock, respectively. An anomalous gold value (90 ppb) is also reported from the syenite intrusion (Chorlton 1987). Chorlton (1987) reported up to 24.6 ppm gold from small quartz-carbonate-albite veins and 2750 ppb gold from a wall-rock schist adjacent to one of the veins.

Representative assay samples collected from both the Snodgrass LakeProspect and Span Lake area by this field party have been submitted to the Geoscience Laboratories, Ontario Geological Survey, Toronto. The results from these samples are pending.

The lithologic package, associated alteration types and structural style as discussed previously were alsc observed by the authors at other locations, especially southwest and east of the Snodgrass Lake area (Figure 2). Several northeast-trending shear zones, extending from the south border of the township through the south end of SnodgrassLake and northeastward to Span Lake, appear to play an important role in localizing gold mineralization as shown in Figure 2. These gold occurences are documented in the Assessment Files Research Office, Ontario Geological Survey, Toronto, as well as in the Resident Geologist's Office, Thunder Bay.

Mineralization style in the northern metavolcanic unit (NMU) is different from the central mafic to intermediate (CMU) and felsic to intermediate (FMU) metavolcanic units. Gold mineralization in the NMU occurs within and around quartz +_carbonate veins which are situated along northeast-trending shear zones (e.g., Huronian Mine, Minoletti and Beaver zones). The auriferous quartz vein at the Huronian Mine is hosted by chlorite + sericite + carbonate schist. A feldspar porphyry is closely associated with the quartz vein, which is known to contain pyrite, chalcopyrite, galena, sphalerite, tellurides and small amount of native gold (Harris 1970).

Shear-zone-hosted gold mineralization potential exists within the NMU and along the contact with the Quetico matesidements. Weak- to medium - strength electromagnetic conductors, albeit discontinuous, occur along the contact zone (OGS 1991b). The contact zone is either strongly sheared or marked by prominent topographic lineaments. Several samples were collected for assay by the present field party along the contact zone. Results from only five samples are available at this time; others are still pending. The samples of sheared gabbro, feldspar porphyry and metasediments from the southwestern contact zones north of the Obadinaw River, have yielded 16 ppb, 55 ppb and 10 ppb gold, respectively (Geoscience Laboratories, Ontario Geological Survey, Toronto). Two samples of sheared gabbro collected from the north-eastern part of the contact zone (about 3.5 km north-east of Rainbow Lake) have yielded 39 ppb and 175 ppb gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

In the extreme north-east corner of the township, a north-east trending shear zone cuts the amphibolitized mafic metavolcanic and gabbroic rocks. These rocks are highly oxidized and contain sulphides (pyrite, pyrrhotite) and magnetite. Medium-to high-strength electromagnetic conductors are coincident with the sheared amphibolites. These sulphidized, sheared rocks should be explored thoroughly for possible gold and base-metal mineralization.

A north-east trending, long, narrow, gabbro sill complex in the middle of the Quetico metasedimentary belt should be explored for base-metal and gold mineralization. Gabbro is the dominant rock type within the mafic sill complex. Other minor phases include leucogabbro, amphibolite and diorite. The contact of the sill with the metasedimentary rocks is either sheared or marked by topographic lineaments. Trains of medium-to high-strength electromagnetic conductors (OGS 1991b), which occur along its entire strike length, have potential for possible base-metal and gold mineralization. Two assay samples of sulphide-bearing (pyrrhotite, pyrite) sheared gabbro have been submitted to the Geoscience Laboratories, Ontario Geological Survey, Toronto. The results from these samples are pending. To the west, just outside the township boundary, a copper occurrence has been reported in a sheared diorite body of this sill complex (Harris 1968, 1970).

A mineralized (chalcopyrite, pyrite) plagioclase-phyric gabbro to diorite from a mafic to intermediate intrusive body, situated north-west of Burchell Lake, was sampled for assay by the present field party. This sample has yielded trace levels of gold (4 ppb), platinum (2 ppb) and palladium (5 ppb) (Geoscience Laboratories, Ontario Geological Survey, Toronto.) Results of other samples taken from this intrusive body are still pending. Approximately 300 m east of the township boundary, north of Burchell Lake, a gold-platinum occurence has been reported (GDIF, Resident Geologist's Office, Thunder Bay).

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INDUSTRIAL MINERALS AND BUILDING STONE POTENTIAL IN THE DISTRICTS OF NIPISSING, PARRY SOUND AND SUDBURY

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INTRODUCTION

A program to evaluate the economic potential of industrial minerals and building stone in the district of Parry Sound and parts of the districts of Nipissing and Sudbury commenced in April, 1991. The three districts are within that part of the province designated as "Northern Ontario", and as such are eligible for enhanced incentives for development. The study area is limited to areas of Grenvillian geology; consequently, only those parts of Sudbury and Nipissing districts which lie south of the Grenville Front Tectonic Zone are inlcuded. The study area includes parts of three Resident Geologists' districts; they are defined approximately as follows: Algonquin District south of French River-North Bay-Mattawa; Cobalt District north and east of North Bay; and Sudbury District north of French River and west of North Bay. The project will be completed by the autumn of 1993.

CURRENT PRODUCTION AND EXPLORATION ACTIVITIES

There is intermittent production of dimensional granite in Dana Township; production of building stone and flagstone ("Mica Stone") continues in the Thorne-Eldee area (Basa 1991); and granitic flagstone and veneer are produced at Parry Sound. Private sector evaluation of dimensional granite gneiss and flagstone continues throughout the area.

Silica is quarried in Cosby Township for use as a flux at INCO's Sudbury smelting operations.

Soda spar is produced from pegmatite in Mattawan Township near Mattawa.

Graphite is produced at Cal Graphite Corporation's mine in Butt Township.

A kyanite deposit at Crocan Lake, northeast of North Bay, is in the early stages of development.

PREVIOUS WORK

A study of industrial minerals and building stone in Parry Sound District and the southern part of Nipissing District has been reported by Martin (1983) and Marmont (1991). A study of industrial minerals and building stone in the Sudbury-North Bay area was reported by Vos et al. (1981), while Lacey (1989,1991) described dimensional stone activities in the Sudbury District. The kyanite deposits at Crocan Lake, near Mattawa, have been described by Hewitt (1952) and Vos et al. (1981). Vos (1978) described silica occurrences south of Sudbury.

Geological maps at a scale of one inch to one mile are available for the area north of latitude 46°N (Lumbers 1971a, 1971b, 1971c, 1972, 1973, 1974, 1975, 1976a, 1976b). Parry Sound District has been mapped at a scale of 1:250 000 by Davidson et al. (1982); larger scale maps of parts of the District are by Satterly (1956), Lacy (1960), Bright (1990), McRoberts and Tremblay (1991), McRoberts (1991), Macfie and Dixon (1990), and Culshaw et al. (1988, 1989, 1990).

CURRENT PROGRAM

LITERATURE REVIEW

A review was completed of published reports and the recently compiled GED (Geoscience Exploration Data) files to determine the type and distribution of mineral commodities throughout the study area, and to formulate priorities for field investigations.

Industrial minerals known to occur in the area include silica (in quartzite and garnet (in biotite gneiss), feldspar (in pegmatite, nepheline syenite and anorthosite), gabbro-diabase, vermiculite, carbonates (limestone, marble and carbonatite), mica and building stone.

After considering the current balance of supply and demand for the various commodities, current local developments (notably in kyanite and graphite), and the geology of the known occurrences in the area, it was concluded that quartzite, mica and building stone represented the commodities most likely to present economically interesting targets. Subsequent field work has concentrated on these commodities.

FIELD WORK

Field work is ongoing at the time of writing. To date, most of the work has been of a reconnaissance nature, with the objective of defining more specific courses of study for some of the industrial minerals; and systematically surveying for potential building stone.

Building Stone

There is good potential for large-block dimensional granite and thinly splitting gneissic granite in the study area. Systematic surveys for dimensional granite have previously been reported in Sudbury and Parry Sound districts (MNDM, 1989; Lacey 1989, 1991; Marmont 1991). Fouts and Marmont (1989) and Marmont (1991) describe known flagstone quarries and exploration criteria for such stone, but no systematic surveys have been performed in the project area to identify additional specific resources. Field work in 1991, therefore, commenced with field evaluation of dimensional granite in the Cobalt Resident Geologist's district, and of flagstone in the whole area.

To date, one potential dimensional granite prospect has been identified in a pink granite near Marten River, and an attractive, good-splitting flagstone identified north-east of Burk's Falls. This reconnaissance programme is continuing at the time of writing.

Visits were made to current flagstone quarries at Eldee and Parry Sound. Mr. Paul Pharand produces a micaceous flagstone veneer at Eldee, while Mr. George Boughner produces rough chunks of green, red and satin "Mica Stone" which is a popular veneer. Some of Mr. Boughner's satin stone contains perhaps 30% of colourless muscovite mica. The stone can be crushed easily and may constitute a source of mica.

The Mill Lake Stone Quarry at Parry Sound continues to operate at capacity, supplying this premium stone to a wide market area.

Prior to the field season, the feasibility of conducting a market study for thinly splitting gneisses was investigated. This was prompted by the qualitative conclusion reached by Fouts and Marmont (1989) that there was good potential to supply far more gneissic granite flagstone and veneer to the large markets of south-

ern Ontario local stone.

Discussions with several members of the stone trade in southern Ontario confirmed the earlier conclusions. They felt that far more "Muskoka Stone" could readily be sold in the greater Toronto area. The two main impediments to greater sales are limited supply of stone and shortage of workers trained in the installation of stone (J. Melo, President, Allstone Quarry Products, Schornberg, personal communication, 1991).

The supply of stone is limited by current quarry capacity rather than reserves of stone, which are plentiful.

Many stone masons prefer to work with brick or concrete block. When installing stone, they raise their price two or three-fold, thereby reducing demand for stone. This situation is unnecessary and could be remedied by suitable stone masonry courses. Joe Melo has been conducting such courses over the last few years.

In the light of such comments, it was decided that a formal market study would not serve a useful purpose at this time. However, it is apparent that the stone industry in Ontario is fragmented, information is not readily disseminated within and between the various sectors, and the use of stone is not actively promoted. There appears to be a need to develop a co-ordinated approach to the extraction and utilization of stone within the province.

Kyanite

A visit was make to the Crocan Lake Kyanite deposit in Butler Township, some 50 km north-east of North Bay. The deposit was discovered in 1951, and has been described by Hewitt (1952) and Vos et al. (1981).

The property is owned by the Kyanite Mining Corporation, which currently produces kyantie from mines in Virginia. Reserves of coarse-grained kyanite at Crocan Lake are estimated at approximately 50 million tonnes with a grade of between 10% and 15%. Beneficiation tests are underway, and application has been made to develop a hydro power plant for the mine and mill on the Jocko River, some 3 km to the north. The company expects to produce a coarse-grained product to complement its current output.

A kyanite occurrence near Wanapitei (Wahnapitae), south-east of Sudbury was also visited by the author. These deposits have previously been described by Pearson (1962) and Vos et al. (1981).

No further work on kyanite is planned in this study.

Graphite

Graphite is an important industrial mineral which is widespread in central Ontario. Cal Graphite Corporation is currently producing high-purity coarse flake graphite from its mine in Butt Township, north of Huntsville. Graphite is also produced in south-western Quebec, and several deposits in Quebec and Ontario are at an advanced stage of evaluation. The near-term potential supply of graphite is therefore very high, and could conceivably exceed demand. Therefore, no further work on graphite is planned within the framework of this study.

Nepheline Syenite and Feldspar

Hewitt (1961) and Duke and Edgar (1977) have described the nepheline syenite body in Bigwood Township near the French River. Additional work on

nepheline syenite resources is not timely because existing producers are operating below capacity, since nepheline syenite has lost market share to plastic and aluminium in the container industry.

Soda spar is currently produced in small quantities from pegmatites near Mattawa and shipped to Germany (Basa 1991; Harding 1944).

Numerous other pegmatites are known within the study area (Goad 1990; Hewitt 1967; Vos et al. 1981; Marmont 1991), some of which have produced feldspar in the past. However, most are small, and/or partly worked-out, and thus unlikely to represent significant economic resources. Some may be suitable as mineral-collecting sites or for decorative stone or aggregate. No further examination of pegmatites in the study area is planned.

Several anorthosite/gabbroic anorthosite bodies occur within the study area. Some have previously been described by Marmont (1991); others may be investigated in order to complement this previous information. The high aluminum - high calcium feldspar of anorthosite may find applications in the ceramics, glass and insulation industries, as an abrasive, and as a source of aluminium sulphate for water purification.

Silica

Quartzite is quarried in Cosby Township and shipped to Sudbury for use in INCO's smelting operations. Similar quartzites occur in Delamere and Secord townships, and have previously been described by Lumbers (1975) and Vos (1978). The quartzites contain minor amounts of specular hematite, feldspar, muscovite and sillimanite. The quartzite is crushed to -2 mesh for use as a flux. Finer washed material and screenings are used as road and decorative aggregate.

Similar quartzites occur north-east of North Bay in McAuslan, Clarkson and Poitras townships (Lumbers 1971b; Basa 1991). Samples have been collected for analysis from some of these occurrences.

Vermiculite, Garnet, Carbonates

No field work has yet been conducted on these commodities. Field checking of some sites will be undertaken in order to determine whether further investigations are warranted.

PROPOSALS FOR FURTHER WORK

Field work will continue to evaluate dimensional granite and gneissic flagstone throughout the study area. The granites in the area are remarkable for their diversity of colour and texture. Stones which possess unusual or distinctive characteristics are becoming increasingly popular on the world market, suggesting a need to conduct more detailed surveys in certain parts of the study area. Since silica, graphite and kyanite deposits are currently being exploited or are at an advanced stage of evaluation, there appears to be little justification for further work in these commodities.

Further work on vermiculite, garnet, carbonates and feldspar is pending.

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INDUSTRIAL MINERAL POTENTIAL IN NORTH WESTERN ONTARIO

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INTRODUCTION

The "Industrial Minerals" program was initiated in March, 1991, to stimulate exploration, development and production of industrial minerals in north-western Ontario. This program is jointly funded by the four-year Northern Ontario Development Agreement, a subsidiary agreement to the Canada-Ontario Economic and Regional Development Agreement (ERDA) signed by the government of Canada and Ontario. The primary objectives of the program are: to document and investigate new and previously-known industrial mineral occurrences; to provide client services via property visits, sample analyses and information exchange; introduce public education through prospector classes, oral presentations and poster displays; and increase awareness of northwestern Ontario industrial minerals at technical seminars, workshops and conferences.

MINING ACTIVITY

Currently, five industrial mineral commodities are being produced in northwestern Ontario. Pink granite is produced at two quarries. Nelson Granite Ltd. and Granite Quarriers (G.Q.I.) Inc., west of Vermilion Bay. Railway ballast is produced for Canadian National Railways at the Watcomb quarry east of Sioux Lookout. Canadian Pacific Railways obtains ballast material from a quarry at Dyment, east of Dryden. Diabase is quarried northeast of Thunder Bay by L.T.L. Contracting for use as rip rap in soil erosion projects. Finally, soapstone blocks are extracted by Phil Thorgrimson, from the former Grace Mining Company quarry on Eagle Lake, southwest of Dryden.

FIELD WORK

A total of 31 field visits (Figures 1, 2 and 3; Table 1), representing 18 industrial mineral commodities, were conducted to locate, sample, examine and record high potential occurrences. The following sites were sampled to evaluate their dimension-stone potential:

1. pink quartz monzonite on the LeMay road, northwest of Manitouwadge.

2. white granodiorite from the Dotted Lake area (Schneiders et al. 1991 p. 162 - 168), south of Manitouwadge

3. red quartz monzonite at Pearl Lake in McTavish Township

4. two samples of pink and white granite were obtained from a location alongside the Nipigon River, west of Lake Helen.

5. buff-coloured limestone in the Poshkokagan River area.

6. buff and red marbles from Hughes Point on Nipigon Bay.

7. black and red granites from past-producing quarries, northwest of Marathon.

Samples were cut and polished to evaluate their attractiveness and ability to take

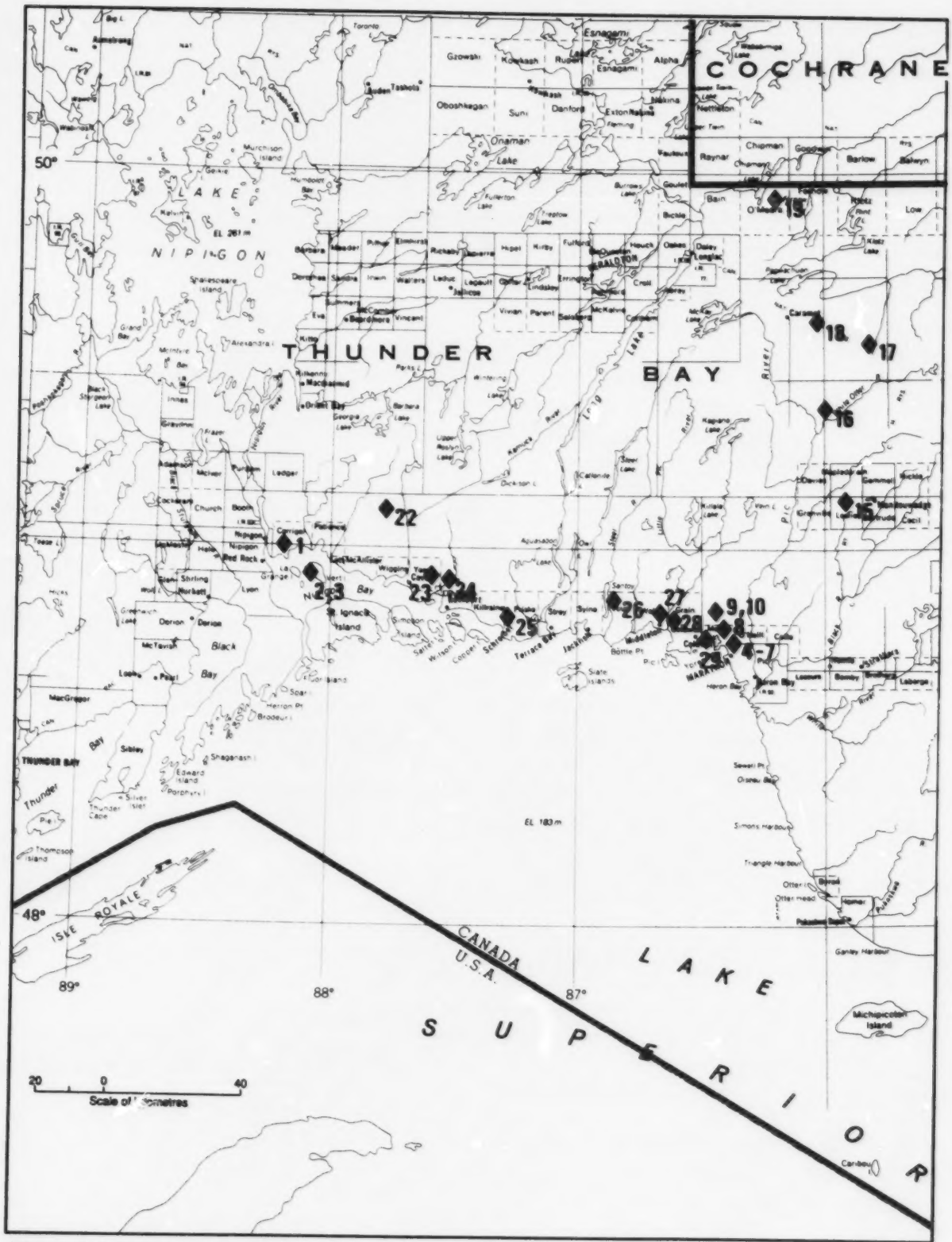

Figure 1. Northwestern Ontario Industrial Minerals Program. ◆ Property Visits, 1991 (keyed to Table 1).

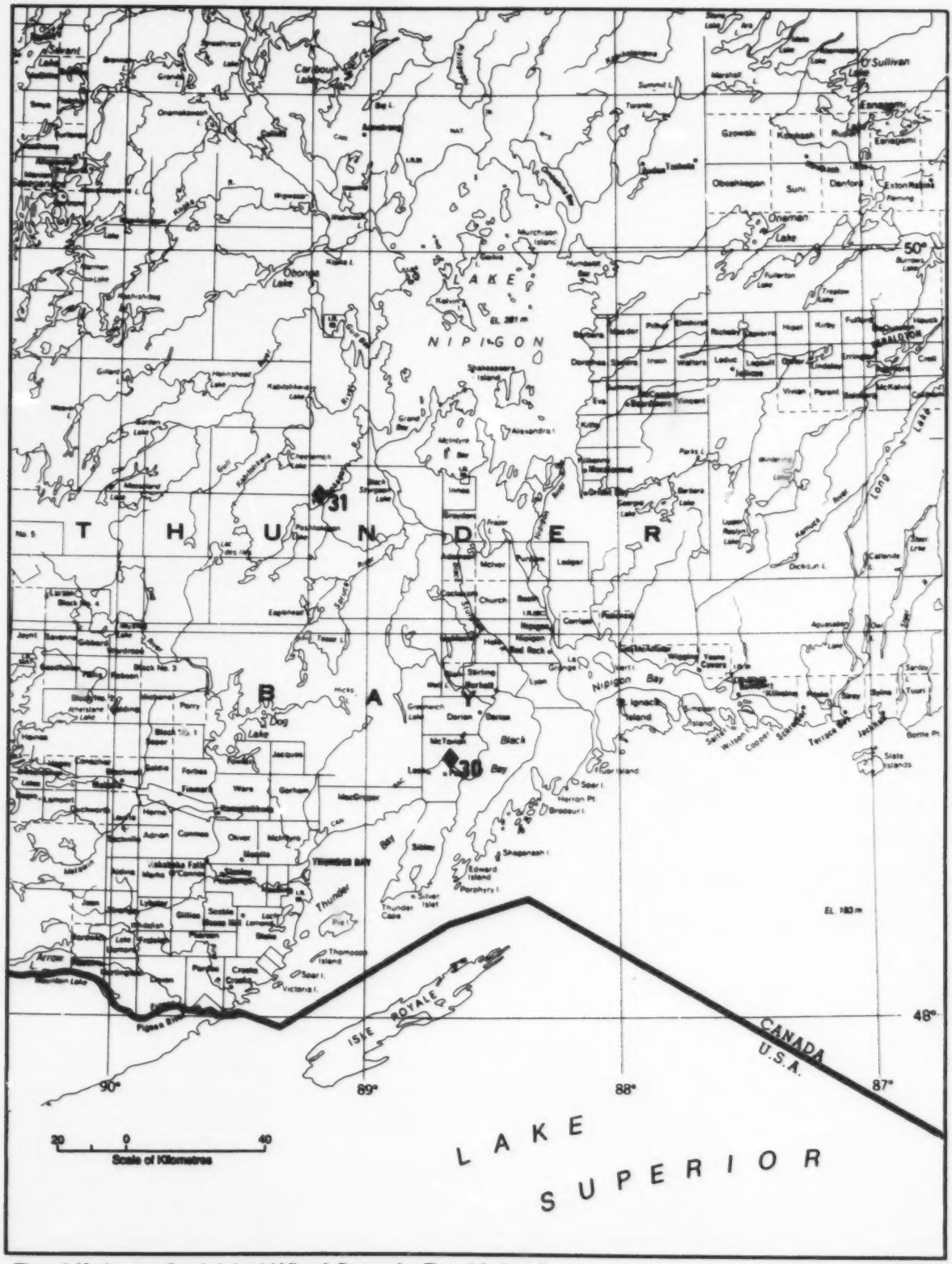

Figure 2. Northwestern Ontario industrial Minerals Program (see Figure 1 for legend).

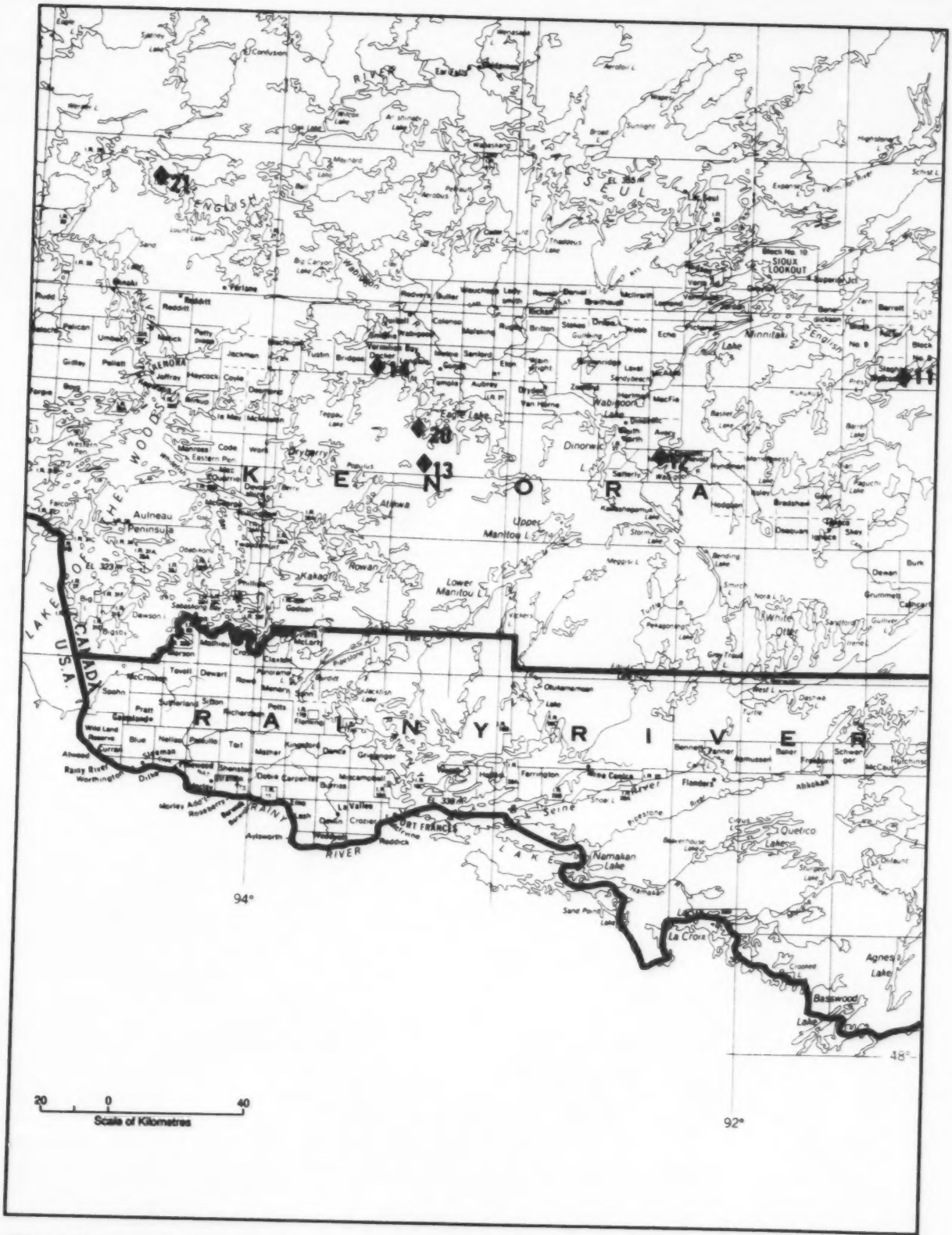

Figure 3. Northwestern Ontario Industrial Minerals Program (*see* Figure 1 for legend).

Table 1. Industrial Mineral Property Examinations

1. Ruby Hill[1]	-marble
2. LaGrange Island	-red sandstone
3. Vert Island	-red sandstone
4. C.S Downey (Shack Lake)	-labradorite
5. Angler quarry	-black granite
6. Peninsula quarry	-red granite
7. Coldspring quarry	-brown granite
8. Port Munroe	-niobium
9. Marathon occurrences	-niobium
10. Geordie Lake[1]	-radiometric survey
11. Watcomb quarry[2]	-railway ballast
12. Dyment quarry[2]	-railway ballest
13. Crystal Quarries Ltd.[2]	-crystal quartz
14. Granite Quarries Inc.[2]	-pink granite
15. Swill Lake[1]	-garnet
16. Lemay Road	-quartz monzonite
17. Taradale Lake	-graphite
18. Little Charon Lake	-graphite
19. Chipman Lake	-rare-earths, niobium
20. Eagle Lake[2]	-soapstone
21. Treelined Lake	-graphite
22. Cypress Lake[1]	-radiometric survey
23. Halonen occurrence	-fluorite, barite
24. Pays Plat	-barite
25. Lafontaine fluorite	-fluorite, barite
26. Santoy Lake[1]	-radiometric survey
27. Dead Horse Creek[1]	-rare-earths
28. Renshaw-Tripp	-titanium
29. Coldwell Lake	-nepheline syenite
30. Pearl Lake Quarry	-red granite
31. Poshkokagan River	-limestone

[1]visited during a field trip conducted in 1991
[2]currently producing

a finish. Further field work will be conducted to establish field parameters required for potential dimensional-stone sites.

OTHER ACTIVITIES

A display, entitled "Industrial Mineral Activities in Northwestern Ontario", was presented at the Thunder Bay Mines and Minerals Symposium in April, 1991, and at the Institute on Lake Superior Geology in Eau Claire, Wisconsin in May, 1991. Oral presentations, dealing with prospecting for industrial minerals, were presented at information sessions and classes for prospectors in the following communities: Manitouwadge, Marathon, Terrace Bay, Nipigon and Thunder Bay. Other activities included attendance at a seminar entitled "Geophysical Solutions to Geologic Problems of Continental Interiors: A Minnesota Workshop" which was held in Minneapolis, Minnesota; and participation in presenting a Mining Sequence display in Manitouwadge and Thunder Bay.

FUTURE WORK

Future work will include the preparation of an Open File Report on industrial-mineral occurrences in north-western Ontario. Classes and seminars will be provided to inform and educate prospectors on both industrial-mineral opportunities and prospecting techniques for industrial minerals. Project results and recommendations will be presented in the Report of Activities 1991, Resident Geologists, which is published in a Miscellaneous Paper Format; this annual report is scheduled for release by the Ministry of Northern Development and Mines in March, 1992.

ACKNOWLEDGEMENTS

This report was edited by K.G. Fenwick and reviewed by B.R. Schnieders. M.C. Smyk provided assistance on a number of property visits in the Marathon area and supplied invaluable information on the geology of the Coldwell complex. C. Komar reviewed this report and provided professional and efficient secretarial support throughout the year along with S. Warren. B. Nelson, Assistant Drill Core Library Geologist, was responsible for the preparation of the voluminous quantity of samples required by this program. Assistance in the field and office was provided by B.Lucas whose efforts are gratefully appreciated. Numerous company representatives and prospectors provided invaluable information and field assistance on industrial-mineral occurrences throughout north-western Ontario.

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THE MANITOUWADGE MINERAL DEPOSIT INVENTORY PROJECT

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INTRODUCTION

The Manitouwadge Mineral Deposit Inventory Project was initiated in January, 1991, to stimulate and facilitate mineral exploration and development within a 50 km radius of theTownship of Manitouwadge (Figure 1). Primary objectives include the compilation, research and investigation of new and previously known mineral occurrences in the Manitouwadge area; preparation of an Open File Report documenting these occurrences; provision of client support via property examinations, field trips, sample analyses and information dispersal; and provision of public education via prospecting classes, technical presentations and poster displays. The project is scheduled to run for 2 years and operate in conjunction with the Schreiber-Hemlo Resident Geologist Program. Funding is

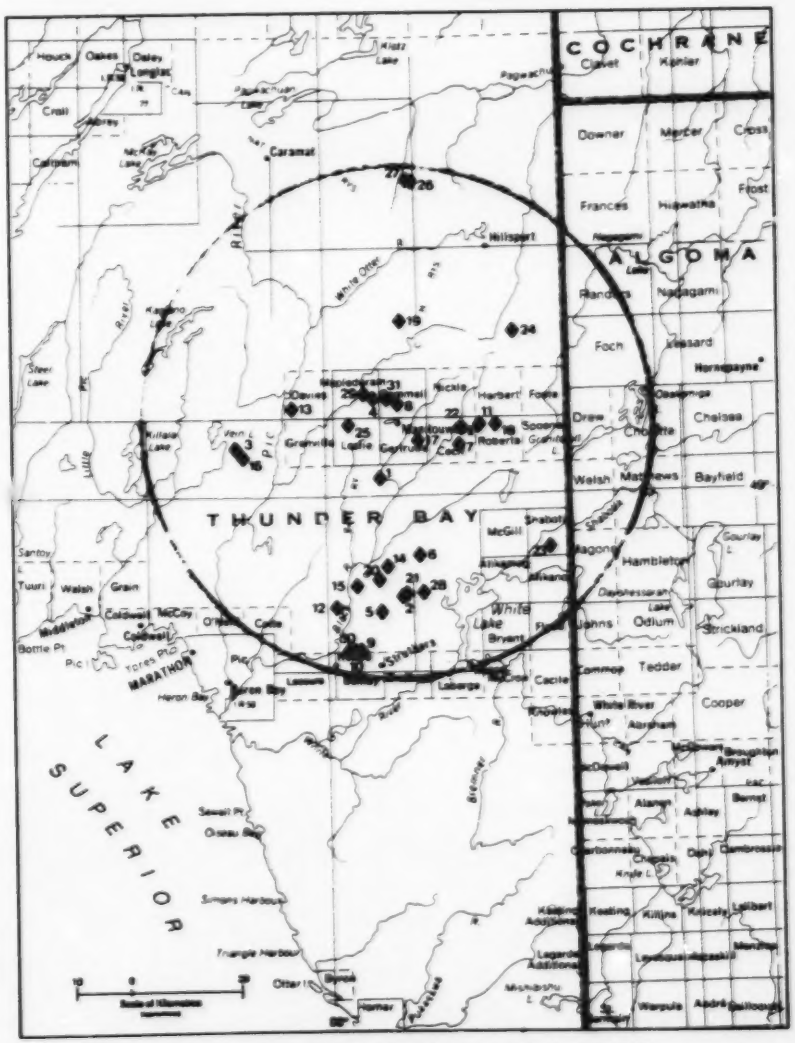

Figure 1. Location map of study area; scale 1:1 220 000

provided by the four-year Northern Ontario Development Agreement, a subsidiary agreement to the Canada-Ontario Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario. It is hoped this project will increase the geological data base of the Manitouwadge area and possibly assist the discovery of new mineral resources to replace those currently being depleted. This report provides a brief summary of activities carried out in 1991. Details will be presented in the Report of Activities 1991, Resident Geologists, which is a Miscellaneous Paper format publication scheduled to be released in March, 1992, by the Ministry of Northern Development and Mines. An Open File Report documenting the metallic and/or economic mineral occurrences in the Manitouwadge area is scheduled for release in 1993.

MINERAL EXPLORATION AND MINING ACTIVITY

One base metal and three gold mines are currently producing in the project area. The Geco Division Mine (Noranda Inc.) in Manitouwadge has mined over 50 000 000 tons of copper and zinc ore since opening in 1957. At the current production rate of approximately 3 800 tons per day, ore reserves will be exhausted in 5 to 6 years (H. Lockwood, Geco Division Mine, personal communication, 1991). The Golden Giant Mine (Hemlo Gold Mines Inc.), the David Bell Mine (Teck-Corona Operating Corporation) and the Williams Mine (Williams Operating Corporation) all located in the Hemlo area, have been in production since 1985 and produced a total of approximately 1 347 300 ounces Au in 1990 (Vancouver Stockwatch, February 7 and 18, 1991). Based on 1990 data, the Hemlo deposit is estimated to contain a total (mined and remaining) of approximately 18 700 000 ounces of gold (Muir et al. 1991). The project area is being actively explored for gold and base metals by numerous prospectors and several major exploration companies including Noranda Inc. (Geco Division), and Noranda Exploration of Canada Ltd. Two new base metal occurrences (the Lampson Road Cu Zn occurrence) have been discovered by prospectors in 1991 in mafic metavolcanic and metasedimentary rocks located approximately 30 km south of Manitouwadge (Figure 1). The discovery of the Theresa Lake Cu occurrence resulted from funding provided by the Ontario Prospectors Assistance Program (OPAP). Assay results are pending.

Table 1. 1991 Property examinations, Manitouwadge Mineral Resource Geologist

1. Agonzon Lake Mo occurrence
2. Armand Lake
3. Baarts-Donaldson Cu occurrence
4. Big Nama Creek Mine1,3
5. East Barbara Lake Sillimanite occurrence
6. Fairservice Zn occurrence
7. Faries Lake
8. Geco Division1,2
9. Golden Giant Mine2
10. Hemlo Highway Section
11. Ice Cream Lake sulphide occurrence
12. Kusins Pb-Zn occurrence
13. Labrador Cu occurrence
14. Lampson Road Cu-Zn occurrence4
15. Lenora-Argentex
16. Lloyd Davis sulphide occurrence
17. Morley Lake Cu occurrence
18. Moshkinabi Lake
19. Otter Lade sulphide occurrence
20. Pinegrove Lake
21. Qued Resources
22. Rawluk Lake
23. Shabotik River Cu-Ni-PGE occurrence1
24. Snake Pit sulphide occurrence
25. Swill Lake
26. Taradale Cu occurrence
27. Taradale Lake graphite occurrence
28. Theresa Lake Cu occurrence4
29. Willecho Mine1,3
30. Williams Mine2
31. Willroy Mine1,3

1 visited during field trip conducted in 1991
2 current producer
3 past producer
4 new occurrence

FIELD WORK

At the time of writing, 31 properties had been visited and examined (Table 1; Figure 1). These comprise 19 base metal properties, 9 gold properties, 1 platinum group element (PGE) property, 1 molybdenum property and 1 graphite property. A total of 272 grab samples were collected and submitted for multi element analysis to determine metal content and chemical alteration, where applicable. Property-scale geological mapping was performed on several of the properties.

OTHER ACTIVITIES

Exploration company personnel were provided tours of the Shabotik River Cu-NI-PGE property, in Shabotik Township, and of the Geco Division, Willroy, Big Nama Creek and Willecho mines properties, near Manitouwadge. Assistance was provided to Geological Survey of Canada geologists I. Kettles and E. Zaleski who both initiated projects in the Manitouwadge area in 1991. I. Kettles is studying the quaternary geology of the Manitouwadge area, and E. Zaleski is studying the metamorphic petrology of the base metal deposits in the same area. A flake-graphite occurrence was discovered in the Taradale Lake area, approximately 50 km north of Manitouwadge, and was brought to the attention of P. Hinz, Industrial Minerals Geologist, Thunder Bay. Exploration in the Manitouwadge area was promoted through numerous informal discussions with prospectors and exploration company personnel.

RECOMMENDATIONS FOR EXPLORATION

The discovery of the Manitouwadge and Hemlo mining camps has proven that caution and a fair bit of patience are required when assessing mineral showings in amphibolite-facies terranes. The project area has a history of unimpressive looking mineral occurrences. In addition, deformation, metamorphism and hydrothermal alteration have acted to obscure high-potential rocks, thus making exploration targets difficult to identify. It is suggested that all sulphide occurrences in the project area, regardless of size or lateral extent, be fully investigated. Occurrences of alteration minerals or their metamorphic equivalents, such as garnet, anthophyllite and sericite, merit investigation, whether or not they occur with sulphides.

Gold deposits in the Hemlo area are hosted by sericite-muscovite pyrite schists in amphibolite-facies rocks and appear to have a genetic association with quartz-porphyritic, felsic intrusive and volcanic rocks (Schneiders et al. 1991). Such rocks also occur in the Manitouwadge area, and, therefore, these more traditional base metal targets should be explored for their gold potentials Pyritic, quartz-eye sericite schists containing green mica occur on the Armand Lake property, located approximately 4 km west of Theresa Lake. The similarity between these rocks and those associated with the Hemlo deposit warrants further exploration for gold in this area.

Recent geological mapping of the Manitouwadge area by Williams and Breaks (1989a 1990a, 1990b) has identified areas of metasedimentary and

metavolcanic gneisses or "ghost greenstone" previously denoted as granitic rocks by earlier workers. These areas should be thoroughly investigated to determine their gold and base metal potential. The possibility exists that volcanogenic massive-sulphide deposits similar to those in the Manitowadge and Winston Lake camps may occur in the Theresa Lake-Dotted Lake-Black River area (Schnieders et al. 1991). The recent discovery of 2 new base metal occurrences (the Lampson Road Cu-Zn and the Theresa Lake Cu occurrences) in the metavolcanic-metasedimentary rock sequence extending west from Theresa and Dotted lakes serves to illustrate the potential of this area. Recently-released geochemical data (Friske et al. 1991) indicate anomalous concentrations of Au, Cu and Zn in lake sediment and water samples collected from the Theresa, Dotted and Pinegrove lakes area. Anomalous concentrations of Au, Cu and Zn also occur in lake sediment and water samples collected from the Flanders Lake area, located approximately 45 km north-east of Manitouwadge. All such anomalies should be thoroughly investigated to determine the potential for gold and base metal mineralizatio in the surrounding area. A summary of high-potential areas for gold, base metal and platinum group element mineralization in the project area is given by Schnieders et al. (1991).

ACKNOWLEDGEMENTS

The author is indebted to the many prospectors and geologists who provided assistance during the course of this project. Special thanks are given to B. Schnieders and M. Smyk who supplied invaluable information, conducted numerous field trips and assisted in several property examinations. Several exploration and minng companies and their personnel provided permission for access to various mineral properties, and the author's gratitude is expressed to all. Thanks are also extended to exploration personnel from Noranda Inc. (Geco Division) and Noranda Exploration Company Ltd. who provided assistance in the field for the majority of the summer. B. Nelson provided technical support and lapidary services, B. Schneiders and M. Smyk reviewed and edited this report an◊ C. Komar reviewed and typed the manuscript.

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THUNDER BAY-ATIKOKAN AREA DIGITAL MINERAL EXPLORATION INVENTORY

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INTRODUCTION

Indexes of mineral-exploration data in the Thunder Bay-Atikokan area have been converted from paper-records into a digital format that covers NTS areas 52 A and 52 B (see Figure 1). The project is jointly funded by the four-year Canada-Ontario Northern Ontario Development Agreement, a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario. The main objective of the project is to facilitate mineral exploration by providing a complete and up-to-date index of exploration data over the entire area.

The Thunder Bay-Atikokan area has a high mineral potential. As a result, there is a large amount of exploration activity which is documented in both the assessment files and the mineral-deposit files. The present assessment file inventory system consists of overlays (simple compilations of property outlines inked onto mylar and overlaying this onto a paper claim map) as well as published and unpublished Geological Data Inventory Folios (GDIFs) which are more-comprehensive, nondigital data compilations. Coverage of the area was provided

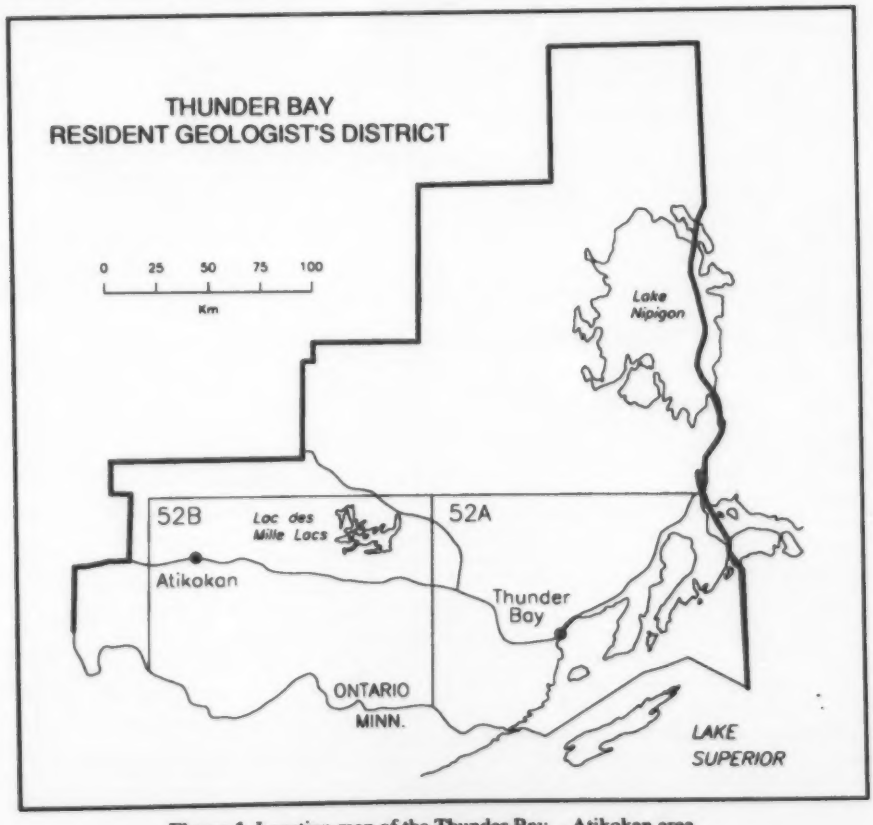

Figure 1. Location map of the Thunder Bay - Atikokan area.

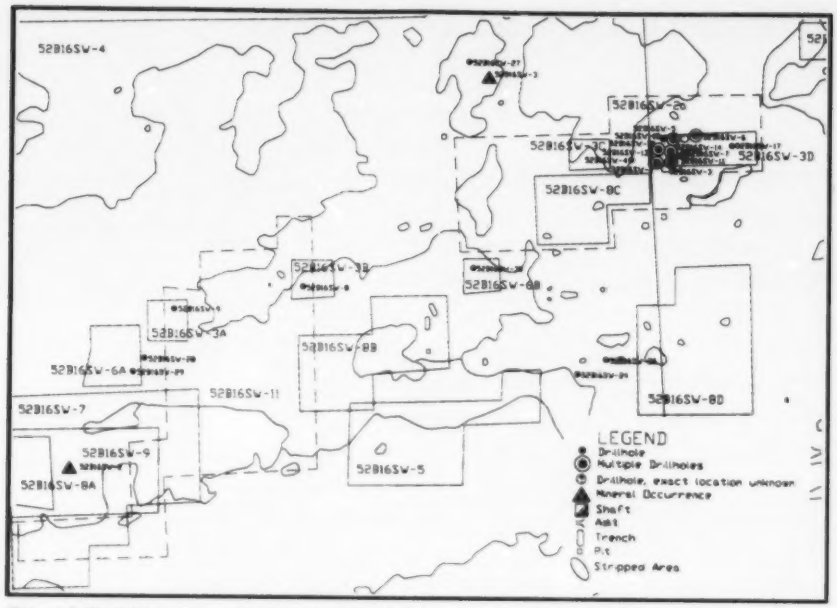

Figure 2. Digital base map with mineral-exploration data superimposed.

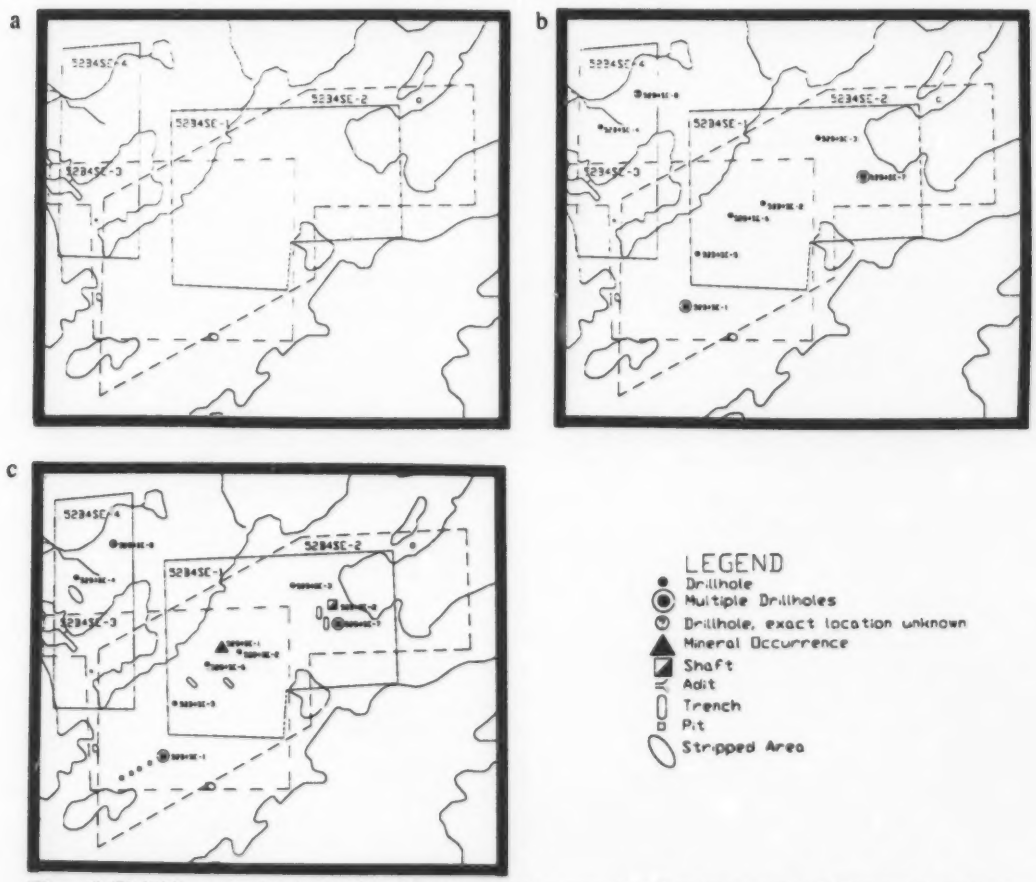

Figure 3. Digital base map showing the following: a) exploration areas; b) exploration areas with drilling; and c) exploration areas with drilling, mineral occurrences, stripping and trenching.

by 19 unpublished GDIFs and 54 overlays. With the creation of the digital inventory, uniform coverage of the area is available in an easily revisable format. The mineral-deposit files are presently indexed via a card-based file system.

INVENTORY CREATION

Digital -Map Creation

Mineral exploration data has been superimposed onto digital topographic-base maps using the computer-aided drafting software Auto CAD. The base maps are separated along NTS divisions, such as 52 A/4 or 52 B/10, and consist of topographic data including such features as roads, lakes, rivers, railways among others. As a function of Auto CAD, each type of data is entered on a separate layer so that they can be individually manipulated through their visibility (layers may be shown or turned off), colour and line type. Layers which have been entered to date include areas of exploration (an outline of areas where assessment work has been applied), mineral occurrences, and drilling, stripping and trenching activities. The information is defined on screen by unique symbols, each with an associated reference number linking it to the data base (see Figure 2). The reference number has been created based upon the NTS area.

Data-Base Creation

The data has been created using dBase IV. Information included in the data base for areas of exploration consists of the company and/or individual who did the work, the work completed and the year. For drilling operations, the company name and company drill-hole number are provided. For mineral occurrences, the commodity is named and the source(s) where the occurrence is mentioned is listed. For each piece of information, the reference number is listed, linking the data base to the map.

BENEFITS

With the digital inventory, clients will have access to current data compilations to assist them in their research. This will reduce the amount of time spent by the client doing initial research on an area.

With the map data entered on separate layers which can be turned "off and on", only the information selected will be displayed (see Figure 3). This will result in easier searches for those needing specific information only. With the use of a plotter, custom maps at both standard and nonstandard scales would be available.

With a digital index, the addition of new information is made much simpler and faster. This will be advantageous in keeping the inventory current and will reduce staff time required for compilation.

SUMMARY

The digitization of mineral-exploration data in the Thunder Bay-Atikokan area has produced a workable inventory with a consistent level of coverage over the area. Information which has been entered to date includes areas of exploration, mineral occurrences, and drilling, stripping and trenching activities. The inventory is amenable to the addition of other geotechnical data to provide a more detailed compilation in the future.